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ABSTRACT

This student text focuses on the social and geological history of a river basin. In addition to background information, the text includes student worksheets for 12 field trip stops in Ohio's Rocky River Valley. Material is designed to support a full-day field trip during which students work in small groups. Also included are a geological time-table, a glossary, and a bibliography. This publication can serve as an example for other schools who want to develop similar programs. (Author/RE)

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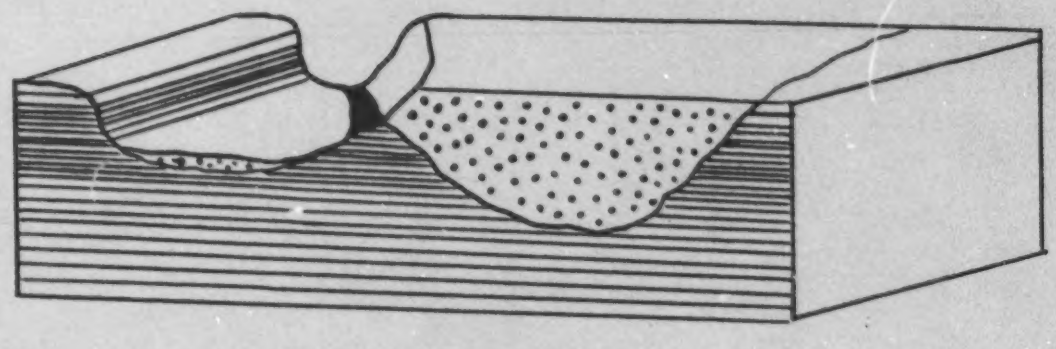

Mary Ellen Cabbage

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Gordon E. Rodeen, Ph.D.
Superintendent of Schools

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A PROJECT ENRICH PUBLICATION
Peter M. Metro, Director

THIS GLORIOUS MUD PILE

(ROCKY RIVER VALLEY)

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(REVISED)
March, 1978

ABOUT THE TEXT

This Glorious Mud Pile is a student text focusing on the social and geological history of the Rocky River Reservation from Lake Erie to Berea.

In addition to background information, the text includes student worksheets for twelve significant stops throughout the Rocky River Valley.

The material is designed to support a full day field trip during which students work in small groups. Preparation for such a trip should include a thorough study of this text.

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THIS GLORIOUS MUD PILE

Ever stop to think about this huge mud pile on which you live? Millions of years and many changes have prepared this area so we can use it as we do today. Look around the City of Rocky River. Everything seems fairly permanent. The houses appear to last forever, and the many new homes soon fit into the neighborhoods as if they had always existed. Oh, occasionally we notice some changes taking place -- especially after a big wind and rain storm. Trees are down, some land eroded, and many areas flooded. Because these changes come quickly, we notice them. However, these aren't the only changes that take place. Everything is constantly changing. Sometimes the changes transpire so slowly we are not aware of them. Some are so minute and subtle they are unobservable. And if someone tries to tell us about these subtle changes, we have a difficult time comprehending what is really happening.

What did the City of Rocky River look like before it became a city? Even before the pioneers and settlers? Go back further -- even before man arrived. What was here? Were there trees in this area? Plants? Animals? Venture a guess! How many years ago did first life exist in what is now the City of Rocky River?

We can solve the mystery of what this land was like millions and millions of years ago by studying the rocks and soils of this area. Carbon 14 data, layers of soil, rock depths, and land formations give us plenty of information. If we take the information we already have and combine it with our observations and new discoveries, we arrive at some of the answers as to what the old, old Ohio was like.

We know that corals live in the sea and are not found in the fresh waters of the rivers and lakes. Too, most ferns and trees live on land; some may exist in very wet areas. Thus, when we find layers of limestone and dolomite containing coral fossils, we know Ohio must have once been covered by sea water. When we find

fossils of trees and plants in other layers, we know there must have been land above the water in much of the area -- at least for a period long enough to grow trees.

Devonian Sea Life
(Figure #1)

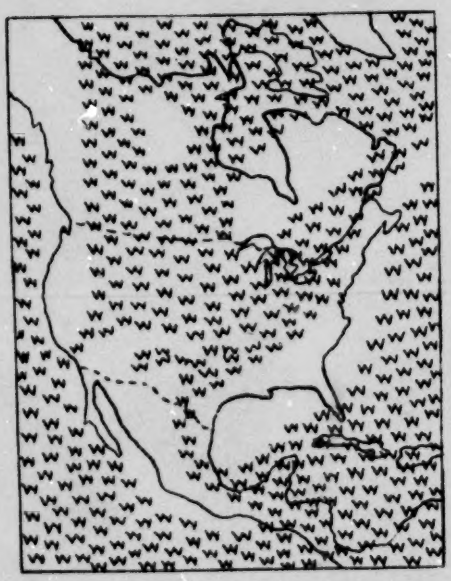
"Ohio Basin Sea" included Rocky River, Cleveland, and the entire state. Not just once, but several times Ohio was covered by water. At times the seas extended from the Gulf of Mexico to the Arctic.

PRE-GLACIAL SEAS

Let's go back even further to the Pre-Cambrian time -- more than 600 million years ago. This is very difficult to do because so many layers of mud, silt, fossils and sand have been deposited and have solidified. Core samples cut into the ground indicate that many millions of years passed between the Pre-Cambrian rocks and the Cambrian seas. During these millions of years, erosion caused large mountain chains to be leveled. Water was slowly wearing, dissolving, and carrying rock material away. Gradually crevices and valleys were filled. Scientists believe that the area that is now Ohio was left a featureless plain.

Cambrian Lands and Seas
(Figure #2)

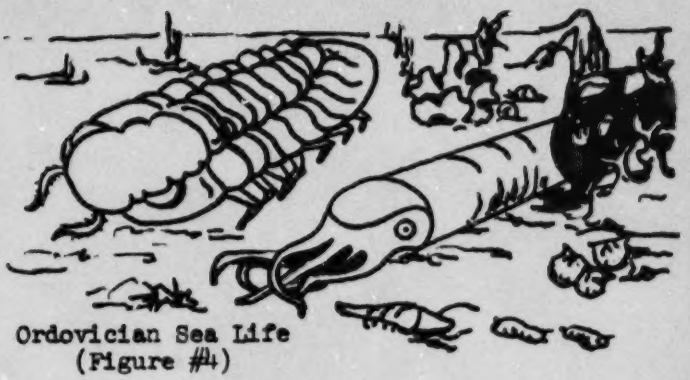
With the Cambrian seas on North America, sea life also appeared. Up to this time there was no evidence that there was any life in the Ohio region; however, some algae and remains of lower invertebrates were believed to have been found in some other places in North America. During most of the Cambrian period, Ohio was above water level.



Ordovician Land and Seas
(Figure #3)

By the mid-Ordovician period, the entire state of Ohio was under water. There were no such landmarks as the Great Lakes. All appeared as one vast sea. At times, different sections of the state would emerge as little islands. Scientists believe that this emergence of land was partially caused by pressures inside the earth resulting from pressures on the outside of the earth (isostasy).

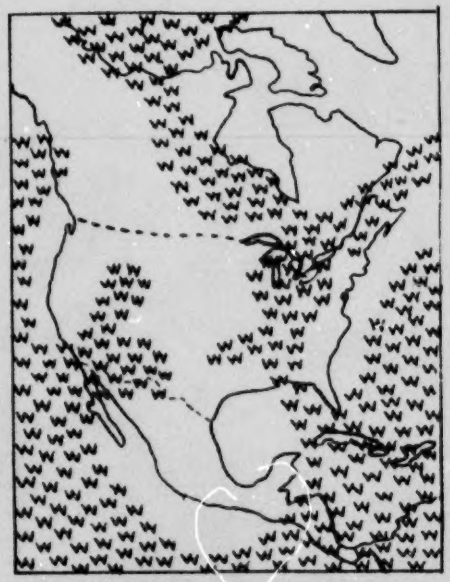
The type of limestone layers indicates that the climate in Ohio was much warmer during mid-Ordovician time than it is at the present time. Scientists have arrived at this conclusion because the limestone layers found here are the same kind of limestone layers that are forming around the Bahama Islands at the present time. Consequently, it can be surmised that today's Bahamian climate was present here years ago.



Ordovician Sea Life
(Figure #4)

Marine creatures were abundant in these waters. There were seaweeds, clams, snails, lobster-like creatures, and other strange looking animals. Trilobites and corals are probably the ones with which we are most familiar even though these animals existed in other parts of Ohio long before there was any life in Rocky River. Quarries around Cincinnati contain trilobites, while corals are prevalent in the dolomite in western Ohio. Some of the Ordovician plants and animals have chemicalized into oil. Their soft body parts went through complex changes to form oil which was trapped in rocks and crevices.

The water retreated at the end of this period but returned during the Silurian time. In fact, water was advancing and retreating over the area several times during each of these periods.



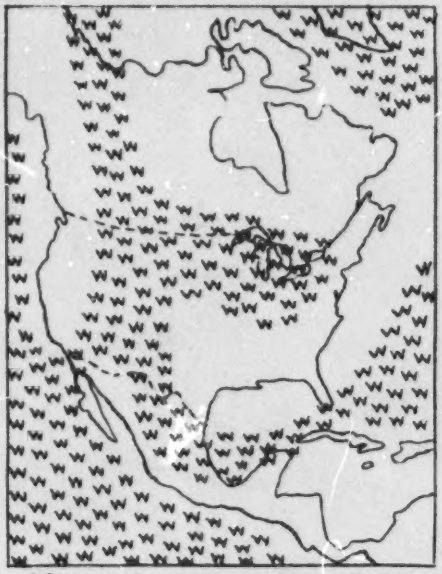
Silurian Land and Seas
(Figure #5)

By the mid-Silurian period Ohio was again covered with water. Sometimes the water was muddy and sometimes it was clear. Some shales, limestones, and dolomites were laid down as the waters moved in and out. Still Cleveland was not greatly affected until late in the period when the sea was sometimes shallow and completely cut off from the main body of the larger seas. Water evaporated, leaving a salt bed from 2 to nearly 50 feet deep. This salt was preserved when it was covered over with mud. Salt in the Cleveland region is under about 1,300 feet of younger rocks; in some areas it may be as far down as 4,767 feet.

Early Upper Devonian Marine Flood
(Figure #6)

Ohio was land during the early Devonian time; but later, practically the entire state was again covered by water -- all except the Cincinnati Arch in the western third of the state. The late Devonian time is the period when some of the sedimentary formations (Chagrin shale, Cleveland shale) that are seen in the Cleveland Metroparks were deposited. It is also the time when great armored fishes and primitive sharks were swimming in the seas of the Rocky River Valley region. For millions of years, sea would cover the land. During this time great quantities of sediment would collect on the sea floor. Then, with a gradual rise in the earth's surface, the water would drain away. The sediments would remain where deposited as the water receded and the land emerged again. Many years later another submergence would cause a new sea to be formed. New sediments would be added to the sea's floor. This process repeated itself over and over again, forming the shales (consolidated mud) and sandstone (consolidated sand).

Some scientists believe the upper part of the Cleveland shale formation was deposited at the beginning of the Mississippian time and other scientists hold to the late Devonian period theory, so the origin of Cleveland shale is still a matter of dispute. During later Mississippian time, streams flowing from the north built a long narrow delta of red mud and a combination of gray silts and mud.



Mississippian Lands and Seas
(Figure #7)

This sclidified and now comprises the Bedford formation. There was a period of minor uplift which caused some erosion of the Bedford sediments. Later the coarse sands found in the Berea formation were deposited. Still there were more seas and additional mud sediments deposited.

Animal life was as prevalent during the Mississippian time as it was during the Devonian period. However, the seas were not clear during the Mississippian period in Ohio; so, the sandy layers do not have many fossils.

During the Pennsylvanian period, Ohio frequently looked like the great coastal plain swamps. At that time, Ohio was a low-lying marshy area densely covered with trees and other plants. Gradually the sea level rose. Salt water crept in killing the great thicknesses of plant debris, including trees. Then the swamps were buried under sand and mud. The weight compressed the plant debris. This caused a slow chemical change and coal was formed.

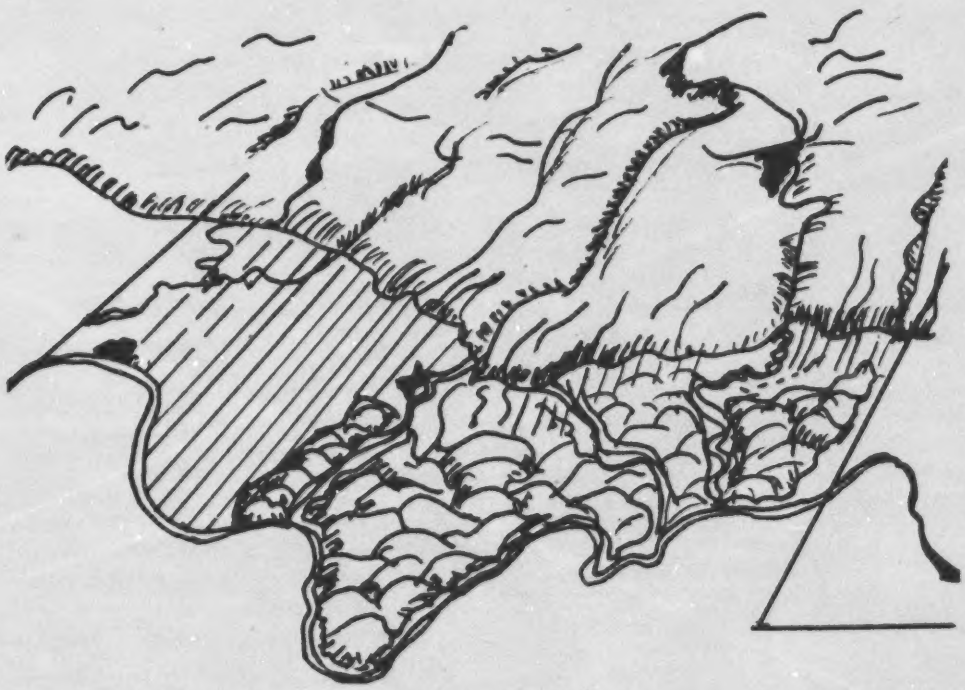
Erosion has destroyed any record of the Permian period in Ohio; however, with the Permian period came the end of the seas in Ohio.

GLACIATION

Between the time of deposition of the Berea Sandstone and the advance of the Great Ice Sheet, nearly 300 million years passed. About a million years ago, the climate cooled 5 - 10 degrees in North America. This caused the snow to accumulate more rapidly than it was melting. Some of the questions that we need to think about are: How long ago were the glaciers in Ohio? How thick

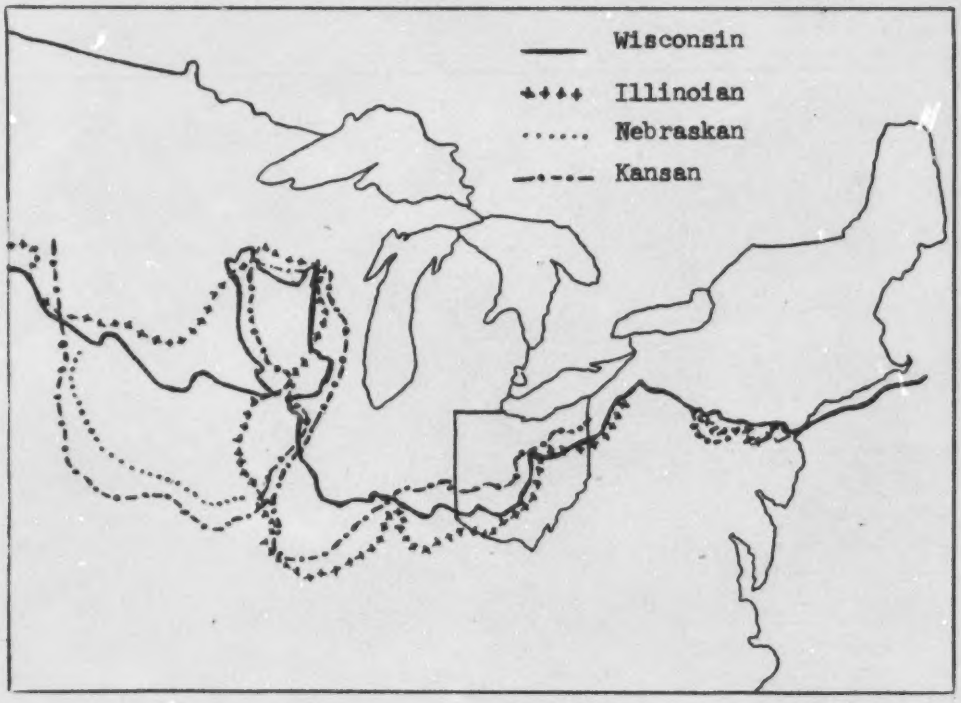
were they? How did they affect Rocky River? How fast do glaciers move?

Glaciers are thick towards the center and thinner near the forward moving edges. In order to move, the ice must be about 200 feet thick because glaciers move out from their own weight. It's somewhat like pouring thick pancake batter on a griddle. It will continue to spread as more weight (batter) is added to the center. The sloping front area of the glacier is simply shoved ahead by the pressure and flow of the thicker ice behind it. Glaciers do move slowly. The last glacier reached Cleveland about 25,000 years ago. Yet it did not get to Columbus until about 23,000 years ago. Imagine taking 2,000 years to go the distance we can now drive by car in a little more than two hours. The same glacier reached Cincinnati 20,000 years ago -- 5,000 years to travel a four-hour car trip.



Artist's Concept of the Effect of Glaciers on Ohio
(Figure #8)

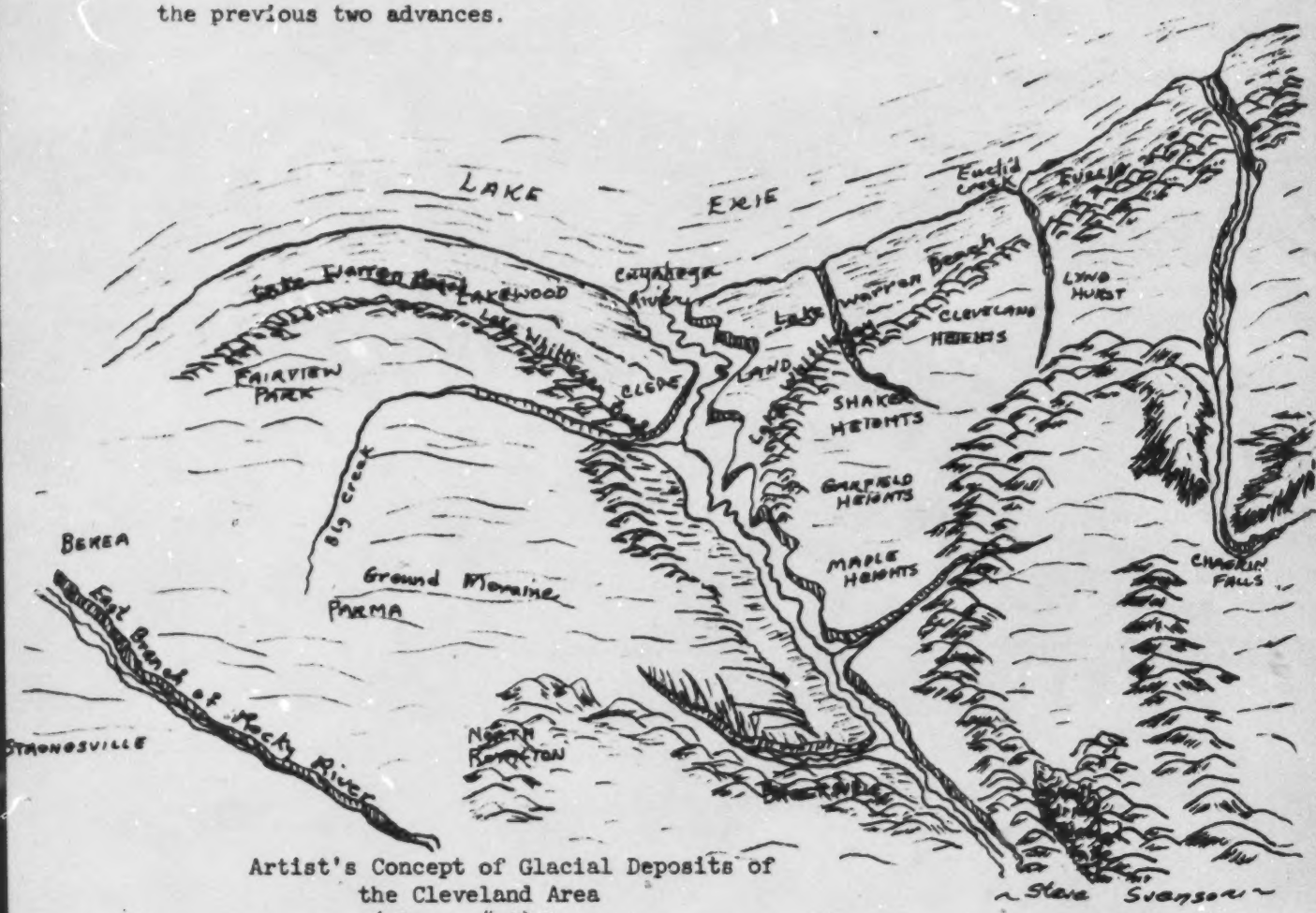
Many questions remain unanswered. Scientists have speculated but do not really know. What are your speculations on these important questions? What happened to cause the climate to drop 5 - 10 degrees so that more snow remained than melted? Why did the ice finally melt--recede? There is no geological evidence that such a phenomenon had ever happened before -- why did it happen then?



Major Glacier Invasions
(Figure #9)

About 700,000 years ago, the first ice age began (Nebraskan); however, we do not know with certainty that it had any effect on Ohio because the newest glacier rubs out many of the evidences of the previous glaciers. We do know that the period of cold was less than the period of warmer weather. Then about 500,000 years ago, another ice advance began (Kansan) and some of its deposits are located on the uplands near Cincinnati. This Kansan Glacier also was relatively short-lived and was followed by a longer period of warmer temperatures.

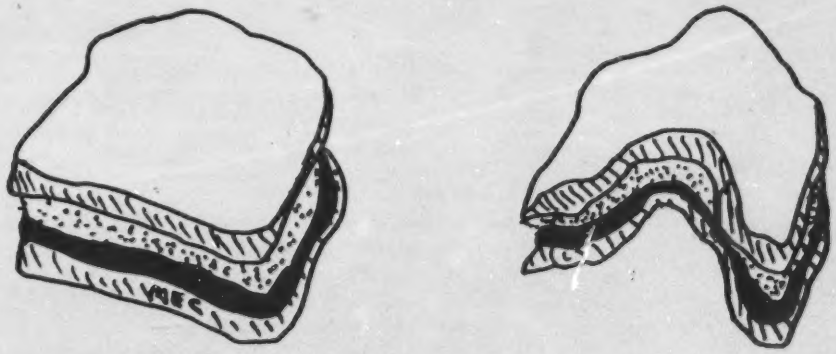
About 150,000 years ago, the Illinoian Glacier arrived and left many deposits in several areas around Ohio. It lasted for a longer period of time than did the previous two advances.



Artist's Concept of Glacial Deposits of the Cleveland Area
(Figure #10)

The Wisconsin Glacier did much to change Ohio with its several advances and retreats. Since the Wisconsin Glacier was the last major glacier in this area, it erased much evidence of previous glaciers and left its own identifying marks. It started about 70,000 years ago and spent from 10,000 - 50,000 years changing the landscape of this part of the continent; much of that time was spent changing the land right here in the City of Rocky River.

Just imagine a huge eraser moving across the land rearranging the surface. This ice eraser scoured the soft bedrock, it broadened and deepened the pre-glacial river valleys and basins, and it shaved off the tops of hills. With this eraser moving and shoving soil about, old river valleys previously formed became filled with till. Some of the loose till was pushed forward to the ice front. The layers of rock previously laid down by the seas were still there under the pressure of hundreds of feet of ice causing some of the layered areas to become depressed and dented. This resulted in some compacting and other changes besides just surface changes. Then as the ice receded and the pressure lessened, the earth responded with an upheaval causing some of the areas to rise at different heights forming anticlines, synclines, and monoclines. Some layers would become tilted and crunched together. Think of a peanut butter and jelly sandwich. The materials have been laid down one at a time -- first bread, then butter, next peanut butter, grape jelly, finally another slice of bread. Now fold and push that sandwich.



Peanut Butter and Jelly Sandwich
(Figure #11)

This is similar to what, through millions and thousands of years, was happening to the earth. The layers did not mix. They were just tilted and angled. This diastrophism is evident all along the Rocky River Valley, especially along the east branch of the river.

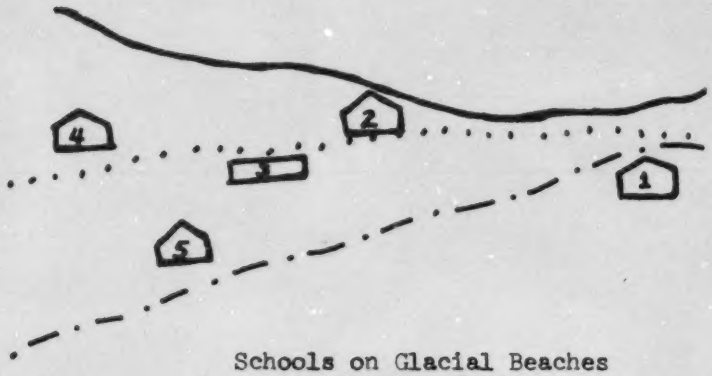
Besides the newly cut valleys and the filled old valleys, additional signs of a glacier are prevalent in our area. The Great Lakes, which includes Lake Erie, were created. Smoothed and rounded granite boulders were carried here from Canada. When the ice front was stationary, debris was left, forming long ridges called terminal moraines. (Bedford and Parma Heights are such areas.)

PHYSIOGRAPHIC BOUNDARY LINES IN OHIO

(Figure #12)

While the ice front was slowly retreating, glacial till or drift was deposited in an uneven sheet over the ground. This is the surface material found in the City of Rocky River. The cutting, shoving, and depositing of the glacier changed the watershed pattern for the state, forcing many streams to work out new valleys -- sometimes even reversing the flow so that now most of the rivers of Ohio flow to the Ohio River. Streams flowing to the north to Lake Erie are small because the divide for the streams flowing north or south is only thirty miles south of Cleveland Public Square. In this area there are approximately 294 square miles forming the watershed that drains via Rocky River.

Most of the Rocky River Public School students have the distinction of attending schools which are located on old postglacial beaches. Bates and Beach Elementary Schools and the High School are on the beach of Old Lake Warren. Goldwood and Wooster Elementary Schools and the Educational Services Center are on Lake Whittlesey Beach.



Schools on Glacial Beaches
(Figure #13)

Key

. . . . . Lake Warren Beach

—.—.— Lake Whittlesey

1 Wooster School

2 Beach School

3 High School

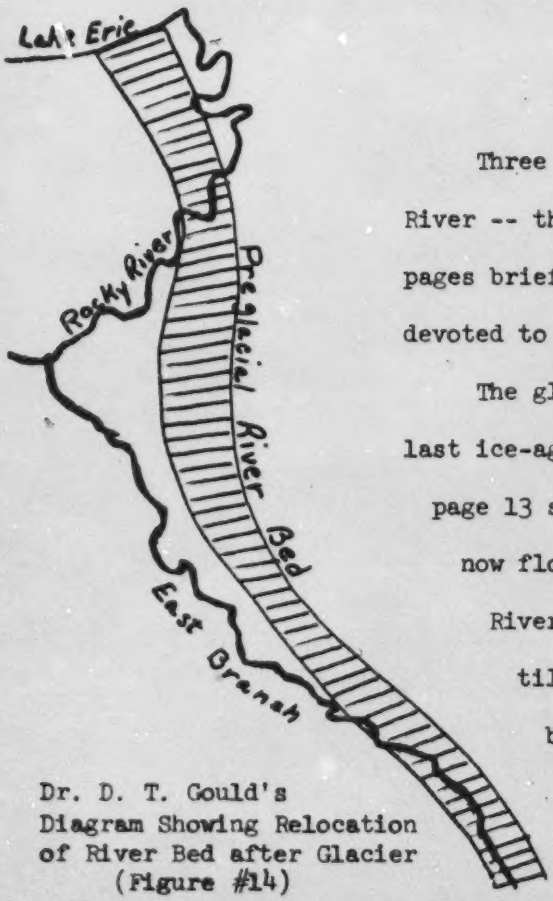
4 Bates School

5 Goldwood School and Educational Services Center

RIVERS

Three major geological phenomena have affected Rocky River -- the seas, glaciation, and the river. The previous pages briefly explain the seas and glaciers. This section is devoted to the rivers -- specifically Rocky River.

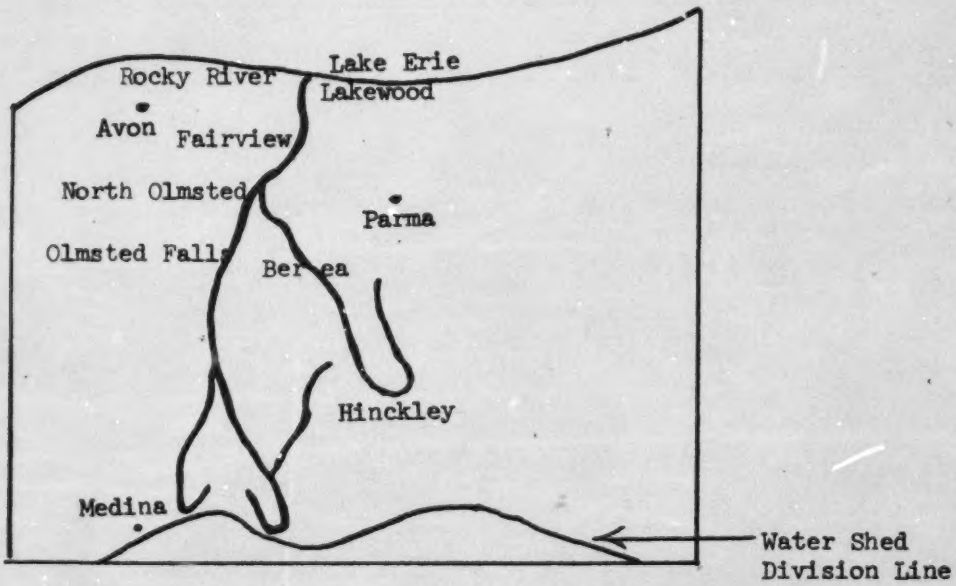
The glacial till that was dumped in this area during the last ice-age changed many river patterns in Ohio. The map on page 13 shows how rivers that previously flowed to the north, now flow to the south, enter the Ohio and the Mississippi Rivers and flow on to the Gulf of Mexico. The glacial till also affected Rocky River and changed its river bed. However, it did not change its direction of flow.



Dr. D. T. Gould's
Diagram Showing Relocation
of River Bed after Glacier
(Figure #14)

It is believed that one million years ago, a pre-glacial river formed a wide, deep valley to the east of the present East Branch's location. At the close of the Ice Age, about 12,000 years ago, the present East and West Branches of the Rocky River began to form the present riverbed by cutting through mud, clay, silt, and ground-up limestone. The rivers flowing north enter Lake Erie, flow along to Niagara Falls and the St. Lawrence River to the Atlantic Ocean.

The map below shows the 294 square miles from which the surface water is drained and fed into the Rocky River. The East Branch is about 35 miles long and has a gradient of about 18 feet per mile. The West Branch is several miles longer and drops about 10 feet per mile. It is approximately 12 miles from the junction of the East and West Branches to the mouth of the Rocky River.



The 294 Square Miles Forming the Rocky River Water Shed
(Figure #15)

Rocky River is a young valley (approximately 12,000 years young), so it is V-shaped, and in some places, has very steep walls. Older, more mature valleys, form a U-shaped valley similar to the valleys cut by glaciers. South of Rockcliff Spring is an excellent view of such a valley.

To really understand the whole picture of the valley, you must know the effect rivers can have on an area. The Rocky River even caused the Cleveland Metroparks to have a court case in 1956. For over thirty years, the river flow caused a cutting and eroding from the park-owned side of the river and deposited the materials a little further downstream on the side of the privately owned property. The deposits built up until the area measured 7,500 square feet. The Park Board believed that since its land on the east side of the river was eroding and causing the building of the west side of the river, that this west side should be a part of the Park System. The judge ruled that the land was deposited by "natural processes of accretion," so it belonged to the private owners.

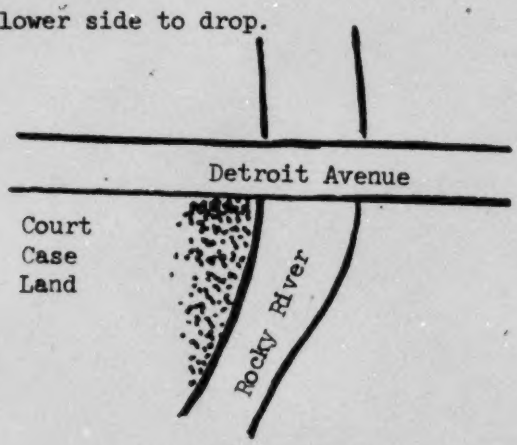
The explanation of how land can be moved from one place to another is quite simple. As the river widens and deepens its valley, it moves in one of three ways: (1) meandering stream cutting a curving path; (2) straight flowing stream cutting a straight path; or (3) the river moving as a waterfall. All three movements can be viewed in the valley.

The court case mentioned previously is the result of the river flowing around a curve. The movement is similar to a bicycle wheel. The outside of the wheel must move more rapidly than the hub to circumscribe a circle. It is similar to playing "Crack the Whip," the same movement is made by a river. As the river rounds the curve the outside edge must travel a greater distance, so it moves more rapidly and carries a greater load. The inside moves slowly and will drop part of its load -- especially if it is slowed even more. The load the water of the river carries is in direct proportion to the river's speed. The faster the river

flows, the greater the load carried -- more silt and larger boulders. The converse also holds true. If the river is not moving very rapidly, it is not strong enough to carry anything but the finest silt.

River Current Speed as Compared to a Wheel
The outside moves faster than the hub.
(Figure #16)

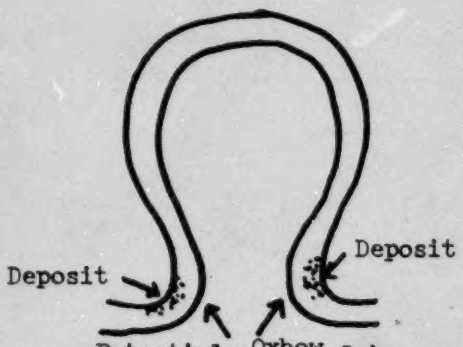
At the place where the deposition caused the court case, the river does not have much of a bend. However, the curve is great enough to cause the fast side to cut and the slower side to drop.



Detroit Bridge and Deposition Area
(Figure #17)

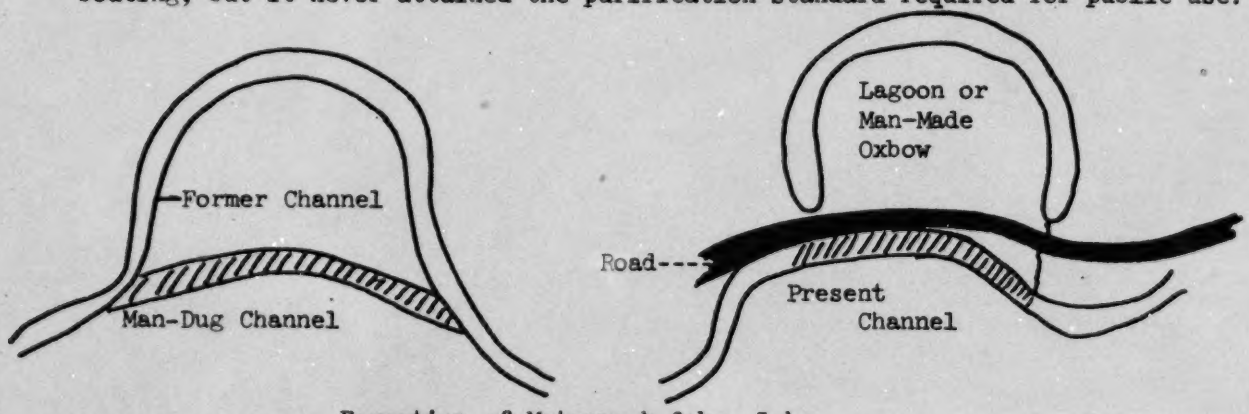
Sometimes this cutting can cause a complete change in the riverbed. Along the Mississippi River, which is a good example of a meandering river, towns which once were on the river are now miles away from the flow. One time prosperous river towns, by being isolated from the power and transportation provided by a river, became deserted. Sometimes the riverbed is changed by flooding. The

flooding may cause the river to find an easier course over which to flow. It may be changed by the U. S. Army Engineers, or the change may be the result of an oxbow. An oxbow is formed by this cutting and depositing action of a meandering stream. The cutting keeps eroding on one side of the river bank, dropping some of the eroded material farther downstream on the slow side. The gradual, but steady process, increases the size of the curve or bend which may speed up the eroding process. This eroding continues until a new bed is cut. The new bed becomes the river's new channel. The old bed becomes an oxbow lake; or if there is insufficient water, it dries up.



(Figure #18)

The lagoon area in the Rocky River Reservation is a man-made oxbow. The swift current eroded the east bank, and during the spring thaws the ice blocks hammered with such tremendous force that the effect could be felt up on Ruple Road. To prevent this force from causing a landslide that could demolish part of Ruple Road, the park made an oxbow. A new, straight riverbed was dug; the oxbow section of the river was dammed, forming a lagoon or lake about 3/4 miles long with depths varying from 3 - 8 feet. This oxbow was intended to be used for swimming and boating, but it never attained the purification standard required for public use.



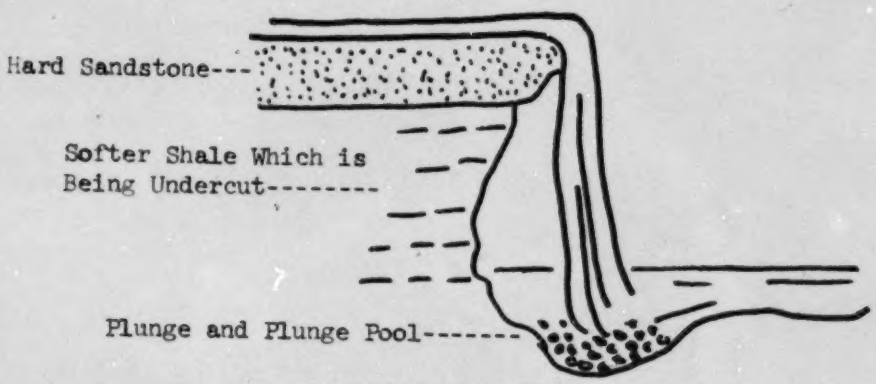
Formation of Metropark Oxbow Lake
(Figure #19)

(16)

The rivers running along a straight channel may not appear to be cutting a deeper and wider bed, but all moving water has power. Along a straight channel the water is cutting materials from along the bottom and the sides. But since it is a straight channel and if there are no obstructions in its path, the water moves with equal speed across its full width. Thus, the materials it carries or deposits are uniform.

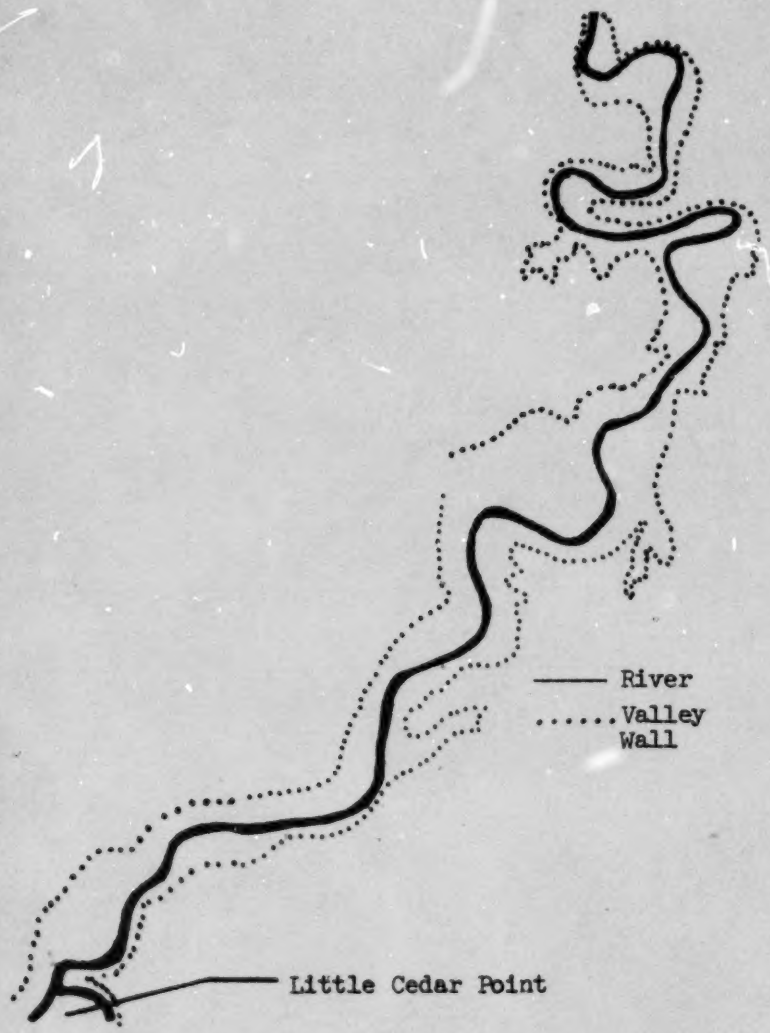
The cutting and reshaping of the valley is not all detrimental. The rich, alluvial soil of the flood plain is the result of river deposition. Even if the upstream end of a piece of land is eroded, much of the material is deposited on the downstream end. Retaining walls can be built to protect specific areas from erosion.

Waterfalls are usually the result of water flowing along a bed comprised of at least two layers of rock with different hardness. The softer rock is eroded, leaving the harder rock as an overhang. The softer Bedford formation and the Berea Sandstone make such a situation at the "potholes" area in the valley.



Mature Waterfall
(Figure #20)

Pirates! You've heard tales of how pirates take goods from other people and add to their own wealth. Our Metroparks has a pirate too! One river has captured another. Evidence indicates the riverbed was changed three times. Do you know where? Perhaps you can find this piracy on your trip through the valley.



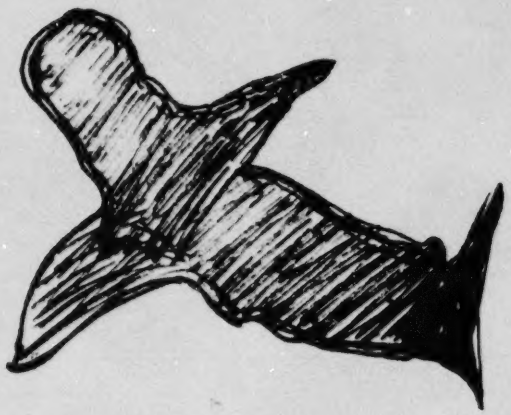
Valley Cut by the Meandering Rocky River
(Figure #21)

The map gives a view of most of the Rocky River Reservation, enabling you to see how the East and West Branches become one as they cut through Little Cedar Point and Old Fort Hill. Also, notice how the river has widened the valley by meandering back and forth. The pre-glacial valley is clearly marked. Since the glacial drift materials yield more rapidly to erosion, this area of the valley is much wider and does not have steep banks.

From this section you have learned how rivers flow, but do you realize that the power of Rocky River was used many times before it reached the mouth at Lake Erie? Are you aware of the thriving little settlements built along Rocky River in the early days because here the settlers could find water power needed for their mills and rich fertile flood plains for their crops? Also, the rivers were teeming with fish, and wild game was hunted in the woods. As you take your tour of the valley, watch for possible sites for mills and settlements. They are there!

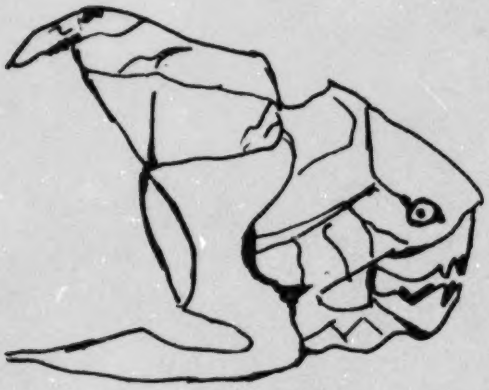
ROCKS EXPOSED IN THE ROCKY RIVER VALLEY

Cleveland rocks are classified as belonging to the Devonian ("Age of Fishes" because that is the time when fishes were the highest type of life existing in the world) and Mississippian Period (period of coal-forming plants and the first insects). Fossils in the Cleveland Shale are scarce, but some have been found -- remains of fishes, fragments of plants, brachiopods, tiny conodonts, and supposed crustaceans. Also, shark fossils five feet long have been found, but there is evidence that there may have been sharks fifteen to twenty feet long. Fossils of Dunkleosteous terelli, a giant armored fish, and Cladoselache, a 300 million year old shark, have been found in the Cleveland Shale of Rocky River Valley.



Shark Fossil
(Figure #22)

Dr. Clark was a prominent fossil hunter during the 1890's. The story is told by his grandson as to how Dr. Clark would spot a fossil high up in the shale bank. If he could not reach it by ladders, he would suspend his son over the cliff from a sling and saddle of rope. Dr. Clark would not bring up his son, Earl Clark, until his son had removed the fossil-bearing shale from the cliffs. Sometimes this would mean many hours of chiseling for Earl



Dunkleosteous terelli
(Figure #23)

Unless it has been carried here by the glaciers, the exposed rock in the Rocky River is all sedimentary. Chagrin Shale is the oldest formation. The "Law of Deposition" sometimes called the "Law of Superposition," states that unless forces have reversed these layers the underlying layer must be older than the overlying layer.

FORMATION	LOCATION	DESCRIPTION
BEREA SANDSTONE	"Potholes" -- Stop L *	Usually light gray. Weathers to buff or dark brown. Sometimes gray stone flecked with brown spots. Composed mostly of pure quartz sand. Loosely compacted so holds a great deal of water.
BEDFORD SHALE	Foot of sledding hill and short distance up-stream -- Stop K *	Red and muddy. Shale often tilted and folded while layers above seem undisturbed. Interbedded with red shale and sandstone.
CLEVELAND SHALE	Park Drive between Mastic Road and Little Cedar Point -- Stop F *	Darker than Chagrin Shale. Bluish to brownish black. Weathers to thin, sharp-edged, slaty chips that are stained a rusty, reddish brown by iron oxide. Lower part some times contains limestone layers one to three inches thick, embedded with cone-in-cone formations. Marcasite and pyrite are scattered throughout.
CHAGRIN SHALE	Scenic Park -- Stop B *	Bluish-gray color. Weathers to a sticky soft clay. Some sandstone layers are interbedded with shale layers. Concretions of pyrite or marcasite are scattered throughout sandstone layers.

* Stops refer to map in Supplement A, page ii.

SUMMARY

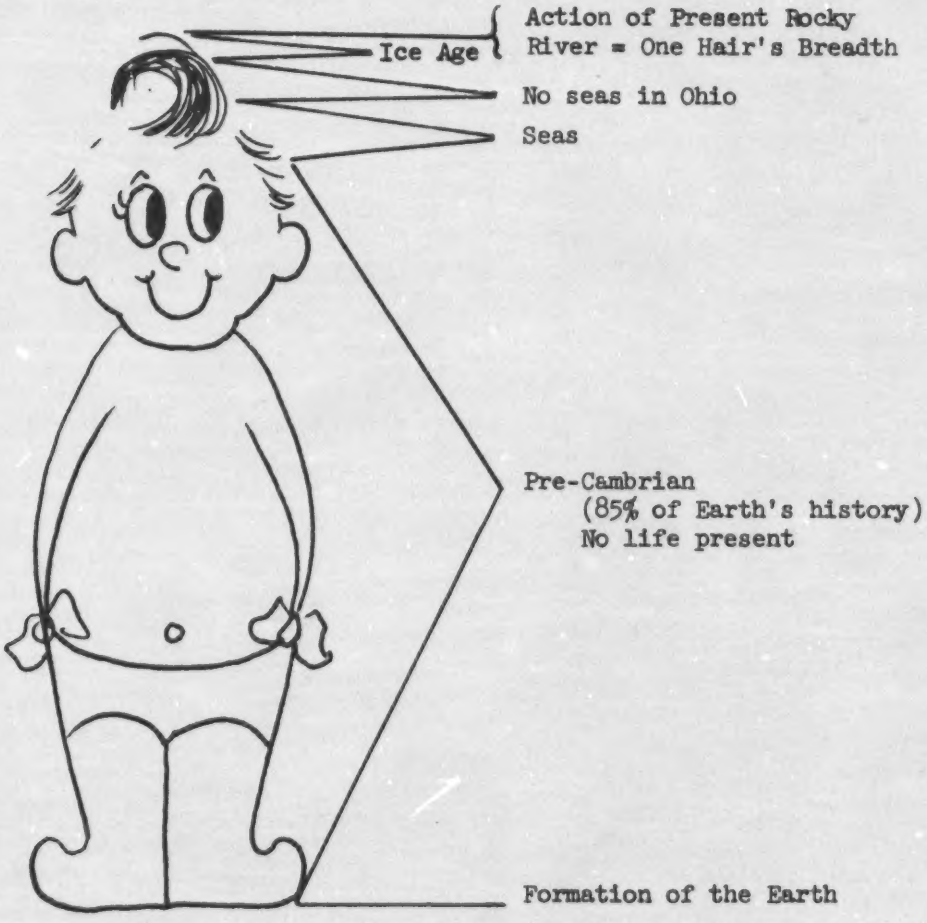
A quick summary on how our huge mud pile came to be as it is today:

It took over 80 million years to lay down the sediments deposited by the numerous seas that covered this area.

Then it took millions more years to change some of these deposits from sand, silt, and sea life to compressed rock of sandstone, shale, and limestone.

During this time, pressures from inside the earth, as it adjusted to pressure outside the earth, caused an occasional uprising and uplifting of the earth's surface resulting in folding of some rock layers.

Approximately another 12,000 years of water action cut the present young valley to its current status.



Comparison of Geological Effect Time Allotment
(Figure #24)

MEN OF FORESIGHT

James Ruple, an early settler at Little Cedar Point, predicted that someday the valley would be "a place where all men would meet and be at home, looking at the beauty God placed there and feel His presence."

His prediction has been fulfilled. William Stinchcomb, another man who appreciated the valley, wanted all men to enjoy the natural beauty found in the woods, rivers, nature trails, and rocks. In 1906, William Stinchcomb began advocating a metropolitan park system and on July 17, 1917, the Cleveland Metropolitan Park came into existence. Stinchcomb became director in 1921.

Nature had already made the area beautiful. Mr. Stinchcomb's idea was to keep large areas in their natural condition as nearly as possible but also to make them accessible. Consequently, according to the standards established by the Park Commission, of the more than 18,000 acres presently comprising the Cleveland Metroparks (5,612 acres in Rocky River Reservation), 85% of the park lands must remain in the natural state and 15% may be developed. To "be developed" means to be made into ball fields, golf courses, bike trails, roads, etc.

Upon William Stinchcomb's retirement in 1949, Harold W. Groth, a resident of the City of Rocky River, continued the work of Mr. Stinchcomb. In 1957, Mr. Groth was appointed the Director. He guided the development and improvements of the Metroparks System until he retired in 1973. The early beginning of Metroparks had the dedicated leadership of these two fine men.

But what is a park without land? Fortunately, many people had the same "Stinchcomb-Groth" dedication to preserving the wilderness as part of the heritage for all men. These generous citizens donated land for the park venture. In fact, most of the park lands have been donated. Only a few parcels were purchased. The first land, about three acres along Rocky River, was donated

by Leonard Schlather on April 26, 1912. This was before the park became official. Mrs. Nadine M. C. Morley then gave 35 acres along Rocky River north of Lorain Road. In order to encourage the development of the park system along the Rocky River Valley, Thomas Macbeth donated all of his property from the edge of the river to the top of the bank. In 1921, Mrs. W. S. Tyler contributed seventy-five acres. This gift meant that practically all the land from Lorain Road to Detroit Avenue had been donated. By January 5, 1922, half the land needed had been acquired.

Today, with land and the natural beauty of unchanged wilderness at a premium, we are fortunate that early in this century men and women -- Stinchcomb, Groth, Schlather, Macbeth, Morley, Coffinberry, Tyler -- had the foresight to plan ahead, and the generosity to share with us this natural, beautiful reservation.

You now have a good background of the geological history of the Rocky River Reservation and have learned of the careful, selfless planning in establishing a fine park system available to us today. Take the trip through the valley and apply this knowledge to your observations. If you find what you think is pre-glacial wood (and it is possible to find some in the Rocky River Valley), do not remove it from its present location. It can only be properly authenticated if the scientists can accurately identify its location and then test for age.

The following pages include additional geological and social history that should make your trip informative and enjoyable. Also, "Supplement A" has maps, challenges, and questions to stimulate your thinking as you go through the valley.

the young flood plain located at (H) on your map. Notice the types of plant growth. The grasses, weeds, and young saplings are establishing roots and will aid by holding the sediments that are building this small island.

Scenic Park was a privately owned amusement park. Because there was so much liquor served, it was a popular park but not considered a very respectable place. Later, under the Beal Law, Lakewood was voted dry. With the absence of liquor, the park's popularity lessened, so it was no longer profitable to operate. In 1917, the City of Lakewood purchased Scenic Park for $43,000 and changed its name to Lincoln Park. Seven years later, July 24, 1924, William A. Stinchcomb presented plans to Lakewood for the development of Rocky River involving "Lincoln Park." Lakewood would still own Lincoln Park, but according to Mr. Stinchcomb's plans, Lakewood would build roads and maintain a playing field. It must have taken four more years for Lakewood to agree to Mr. Stinchcomb's plans. In April, 1928, Mayor Edward A. Wiegand wrote for the Lakewood Chamber of Commerce news magazine, "Lincoln Park has been of no benefit since its purchase, except as a dump." In agreement with the Metropolitan Park Board, he continued, "provisions have been made whereby not only a bridge and roads will be provided for, but also a recreational field developed and maintained on the bottom, which is quite level." In 1956, Lakewood sold the park to the Cleveland Metropolitan Park Board and the name was reverted to the original "Scenic Park."

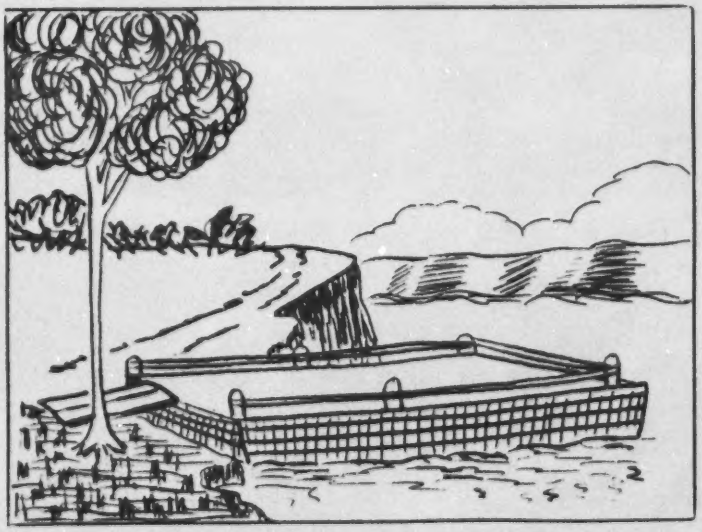
In the early 1900's, the only way to cross the river at the foot of the Detroit Street entrance was a swinging foot trestle. This was replaced by a concrete stream level ford. Several such fords were built at strategic crossing points along the river and were used for many years. Since these fords were so near the water level, they did not prove to be practical. Dangerous winter ice jams would form at the fords and become hazards. Spring thaws and rains, in addition to heavy summer rains, caused high water, flooding the fords and making crossing treacherous if not impossible.

The fords would be closed rendering them temporarily useless. Most of the water level fords have been replaced by higher bridges.

The fascinating water crossings in Lakewood Scenic Park are the East-West ones built along the Cleveland-Huron Road between the two steep shale banks. With settlers entering the area, with cities beginning to be built on each side of the river, and with a mail route (1810) being established between Cleveland and Detroit, a safe means of crossing the river was imperative. Up until this time, the river was forded with spike teams (horse leading two oxen) and was quite dangerous. Many drownings and property losses occurred because in high water the crossing was so hazardous.

Some danger was alleviated by Daniel Miner's ferry, which he operated across Rocky River in 1811 and 1812. The ferry continued to be used as a crossing of the Cleveland-Huron Road until 1821, when the first bridge was built.

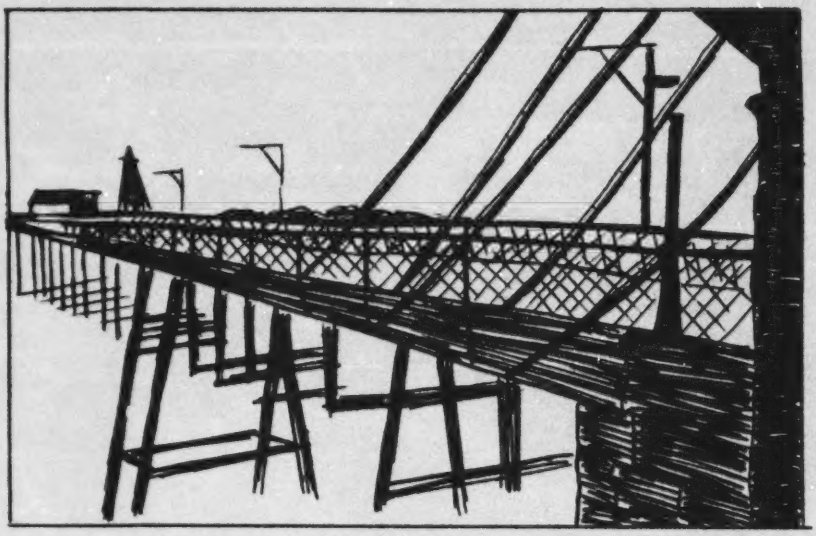
The first bridge, a wooden one, was built just above water level. The co-operation of every family in the township was required as both money and labor were needed. Rufus Wright actually paid half the expenses and directed the building. However, every family in the community provided labor or money, or both. Even though the muddy, steep road leading to either side of the bridge was sometimes inundated with water, this first bridge was considered a great convenience.



Ferry Similar to Daniel Miner's Ferry
(Figure #26)

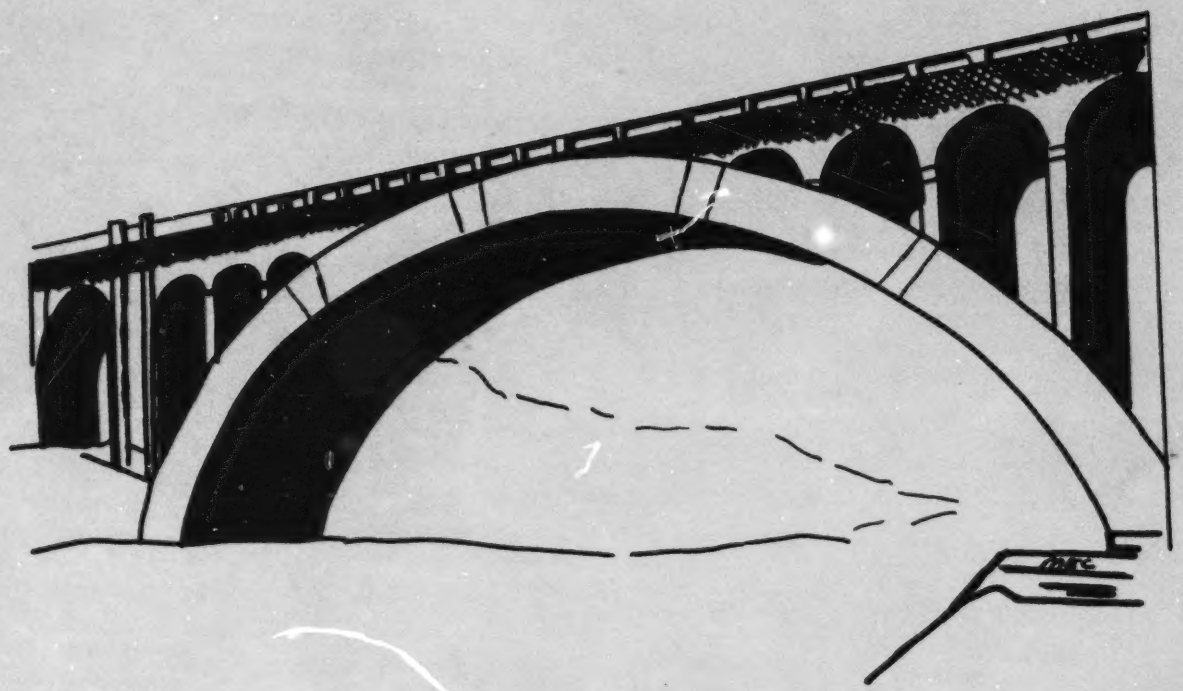
Wooden Toll Bridge
(Figure #27)

The building of the toll bridge was announced in the Cleveland Herald, April 22, 1850. "Every person who has risked life and limb by crossing the rickety old bridge at the mouth of Rocky River, will be pleased to learn that the Rockport Plank Road Company is about to erect a substantial bridge near the site of the old one ... grade the heavy hills and extend their beautiful plank road another five miles this season." This wooden bridge was built halfway up the river bank so it did ease part of the long hard climb; however, a toll was charged for its use -- 7¢ toll for one-horse cart, 10¢ for a team, and 15¢ for a double team. Eventually, the county bought the bridge and tolls were removed.



First Street Level Bridge
(Figure #28)

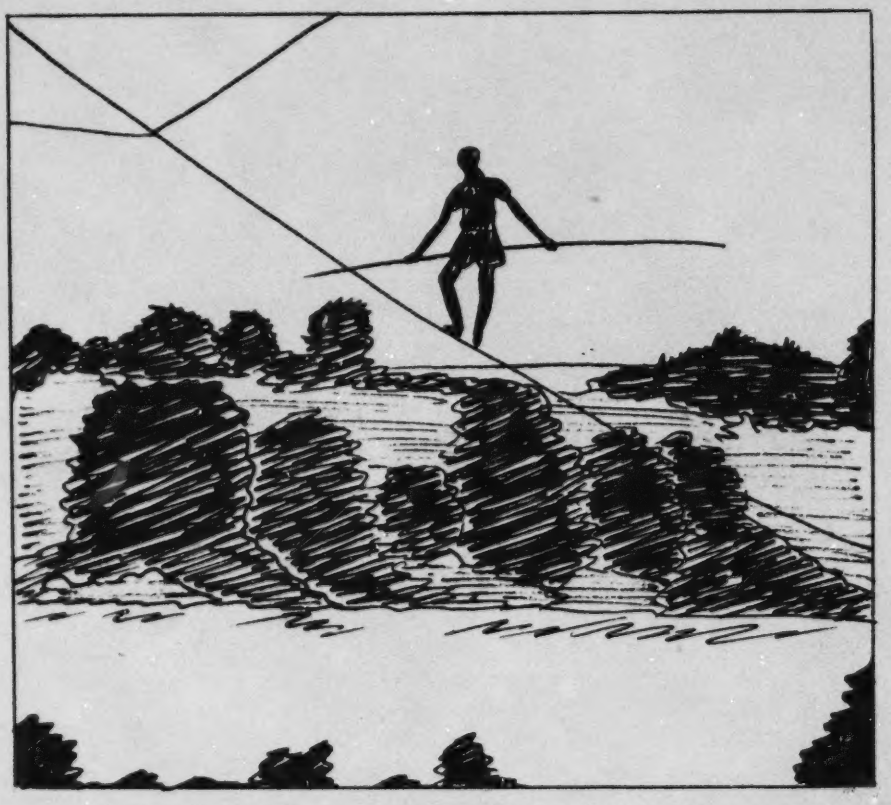
The first street level bridge was built in 1890. It was an iron span costing $60,000, which was a great deal of money in 1890. This bridge was used only 20 years and was replaced by the world-famous concrete arch bridge in 1910.



World Famous Concrete Arch Bridge
(Figure #29)

This Detroit street level bridge, spanning the valley at the northern end of Scenic Park, earned a world-wide record. In 1910, when it was built, it had the longest concrete arch without steel reinforcement of any bridge in the world. This bridge, the fourth built at this particular crossing, will soon be demolished. The present state of disrepair makes it unsafe for heavy traffic, and its angle for entry from either Lakewood or the City of Rocky River makes a "bottleneck" -- especially with the increased traffic. A fifth bridge will replace it.

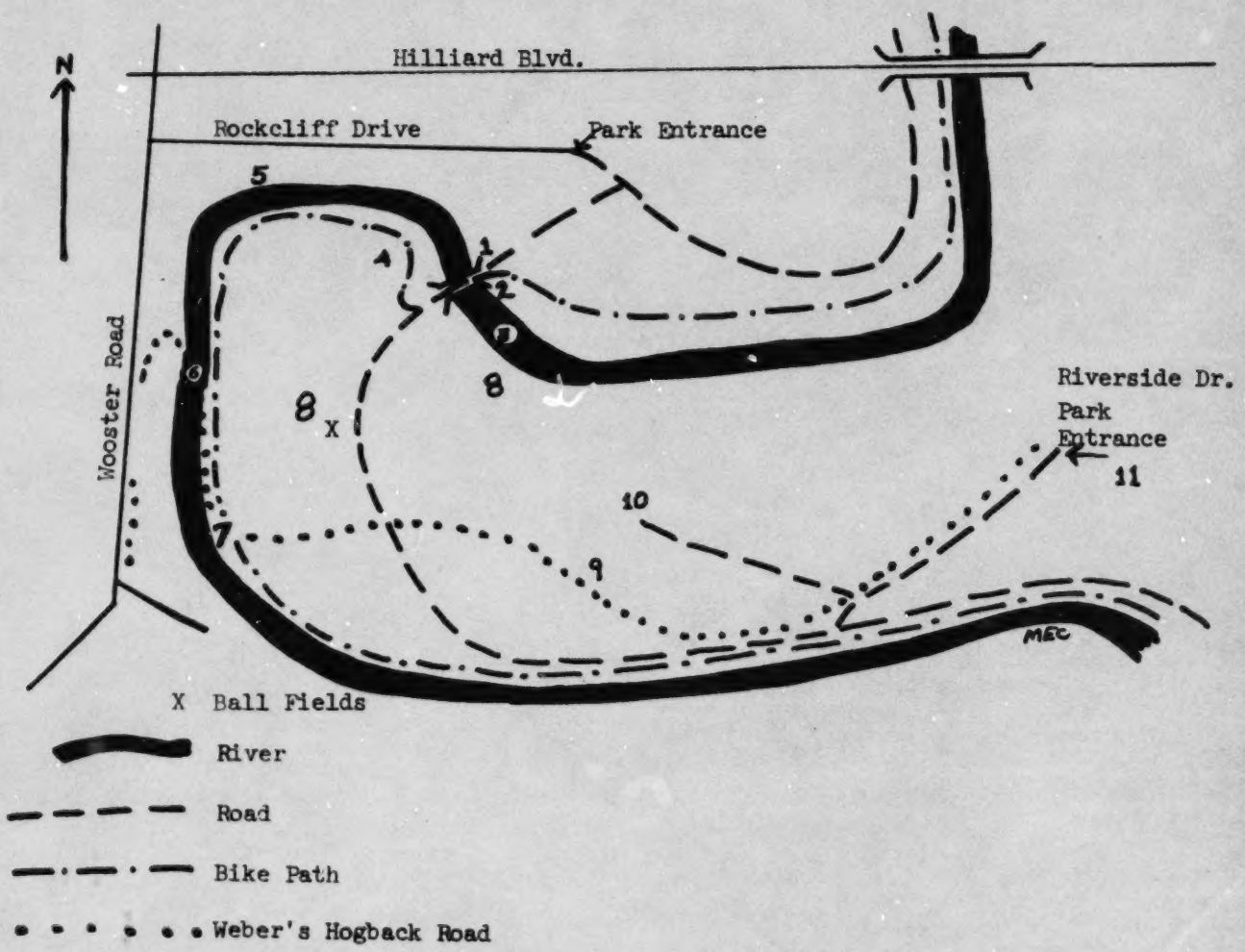
The Rocky River has worked through the years, cutting a path deeper and deeper in the shale bed; however, man with his modern technology has been able to develop safe crossing with very little damage to the environment.



Walking a Tightrope Over the Rocky River Valley
(Figure #30)

Any of these four bridges would be preferable to the crossing technique chosen by Professor Jenkins, tightrope walker. In 1883, he walked a tightrope stretched between the high banks. Some observers claimed he carried a stove and cooked pancakes when he reached the middle. However, no picture exists that includes the pancake episode.

ROCKCLIFF SPRING, GLACIAL TILL, AND STINCHCOMB AREA



Map of Area
(Figure #31)

Years ago, Rockcliff Spring was located near the top of the north side of Rockcliff Road. The original location can be easily identified by the indentation on the ground. The area is still damp enough for skunk cabbage to flourish each March. Since the water was so good and in constant demand, a traffic jam and safety hazard resulted. So, the water was piped to the bottom of the hill where the cars would have ample parking space. In 1959, the spring produced approximately five gallons per minute. The 500 gallon holding tank (1) located about halfway down the hill, has four pipes bringing in water. In the middle of the tank is a single pipe which carries the water to the outlet. In 1967, a new filter bed was installed revealing another source of water. When the new bridge across the ford was built, the carrying pipe was extended under the bridge to its present location (2). Every attempt is made to keep the water pure. Neither the quality of the water nor the volume of the flow has varied much since the spring first opened in 1921. The sign is to warn drinkers that sometimes the water may have slightly more contamination than the state allows.

West of Rockcliff Spring, the pre-glacial valley is exposed (5). Here the glacial till and the shale meet. The porous glacial till allows the water to flow freely. This water is trapped by the sticky clay of Chagrin Shale. The combination of glacial till and impervious shale makes the spring possible. During the pre-glacial time, another meandering stream was busy cutting a channel through these sedimentary layers. It took a different path than the present Rocky River travels. Here, west of Rockcliff Spring, it cut a path making the valley approximately 3/4 mile wide; but, by the lake, the valley was cut to about a mile wide. The pre-glacial river valley must have existed longer than the present 12,000 year old Rocky River, because the old river has been proven to be at least 200 feet below Lake Erie. Could part of its depth have been dug by the glaciers?

Shale

Glacial Till

a Old Valley

b Present River Channel

c Present Flood Plain

d Present Valley

Valley Cross Section
(Figure #32)

Glacial till erodes much more rapidly than the more compressed earth. Notice the gullies on the hillside. Too, traces of the old Weber's Hogback Road have been almost completely erased by water action.

At the flood plain area, the present Rocky River has cut through much of the pre-glacial riverbed. Note the texture of the soil. It is the result of the grinding of the materials of glacial till. There are not many sections in the valley where the banks of the river are of such a sandy texture or black color.

Since this section has much flooding, it gives a first-hand opportunity for viewing how a flood plain develops. Pools of water are trapped on the plain because of deposits forming humps or walls. During high flooding times, the water with a load washes over these walls but cannot return the same way, so it leaves its materials as it drains. The typical vegetation of a flood plain is here -- willows, cottonwoods, and sycamores are the predominant trees.

East of the bridge (3), note the gravel area extending into the river from both sides. This is a natural source for gravel and has been deposited here by river action and rain erosion. The hill to the east has a gravel source that has not been tapped. This gravel section of the river formed a natural ford for crossing that was used by the early settlers before the now-visible old ford was built. In the early 1900's, farmers who lived in the valley used this part of the river to obtain gravel to put on the steep valley road. The gravel was

loaded onto wagons and, with the help of a team of horses, was hauled to the hills.

At one time the whole hillside and ball fields were a community of homes. Instead of being the steep incline we see now, it had three distinct levels. Each level had homes -- about eight or nine on the hillside and four or five more on the ball fields. The Idlewild Tavern and Inn (11) was on top of the hill by the present Riverside Drive entrance. The old Weber's Hogback Road (...) passed the tavern, came down the hill in front of the stagecoach house (9), angled down the hill and cut at the edge of the southern part of the present Memorial Ball Field to the grist mill (7) at the river's edge, went north along the river to (6), where the old sandstone support blocks are still visible. Here the road crossed the bridge, veered to the right, and began its ascent uphill. Since the incline was so steep, the road hairpinned to the left, gradually climbing. This entire area is composed of till, so the road west of the river has been eroded and most of the traces erased. It is again discernible on the hillside near Center Ridge Road. Weber's Hogback Road is believed to have followed Indian trails across the valley and to have been one of the earliest improved travel ways in the valley.

In 1910, when the Burkhardts purchased most of the land, remnants of the homes were cleared away so the entire area could be used for farming. The blacksmith shop was still standing with its heavy anvil inside. The Burkhardts remodeled the old stagecoach house for their home. They were fortunate to have two wells -- a hard water well high on the hill and a soft water well near the home. Traces of the old foundation for the power engine that pumped water and the foundation of the old stagecoach house are visible in the winter when the foliage does not conceal them.

Apple orchards and grape vineyards were on the hillside, corn and other

crops on the flat land; and across the river to the southwest, the soil was rich for the potato patch and walnut trees. As a young boy, Harry Burkhardt, present resident of the City of Rocky River and former manager of the golf course, lived here with his family. He tells the story of how mischievous teenagers were stealing walnuts from the drying racks at night. Because these drying racks were erected on the land across the river, Burkhardt's worker sat up several nights waiting for the boys to return. Finally they did. He waited until the boys had picked several gunny sacks of walnuts, then he approached them and retrieved the harvest. He always felt he was even with the night intruders because the labor of picking the second lot of walnuts was free.

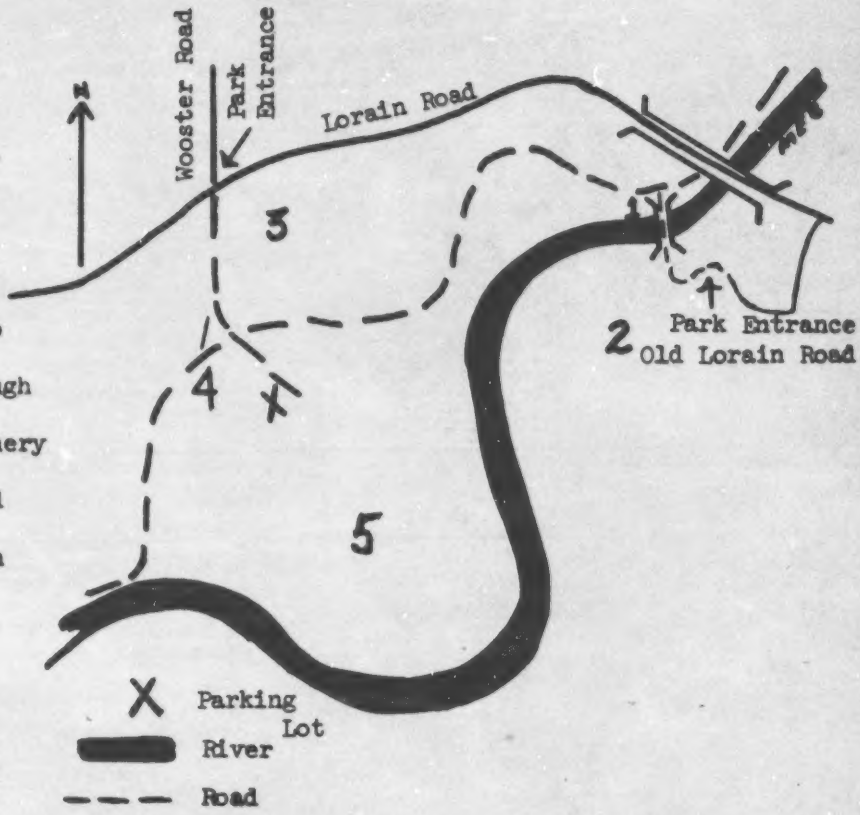
Much natural gas and drift gas lies deep underground in this section. Early in this century, the operator of the grist mill drilled for oil but hit one of the first natural gas wells around here. The power of the released gas spewed rocks, sand, and gravel several feet into the air.

This area is quite different now. Records indicate that the river was moved and the retaining wall built to make the boulevard through the valley possible. Construction began in 1929 and was completed in 1930. A single ford (still visible) was built across the river so the space could house the materials and act as the supply headquarters for the road construction. Instead of good "potato patch soil" and the usual bottom land vegetation, there is now poor soil, lichens. few grasses, some shrubs, and a few trees in a circular area approximately 100 feet across. Records indicate that the rich top soil was removed from this area.

The Burkhardt's land, through a succession of owners, became Stinchcomb's property. That land, combined with the 39 acres purchased from William F. Grosse, was a logical location for the Stinchcomb Monument (10). Fill from the I-90 ditch forms much of the extended Stinchcomb Monument hill but buries much of the romance of the earliest settlement.

"BUBBLE GUM KING" AND "TWO-MINUTE FARM"

Here is where the pre-glacial river cut through the valley on what is now park property. The steep-walled valley changes to sloping valley sides; and a narrow valley opens into spacious fields ample enough for two golf courses, archery range, practice areas, and parking. Glacial till can be seen on the hillside. Occasionally a glacier-scratched rock can be found.

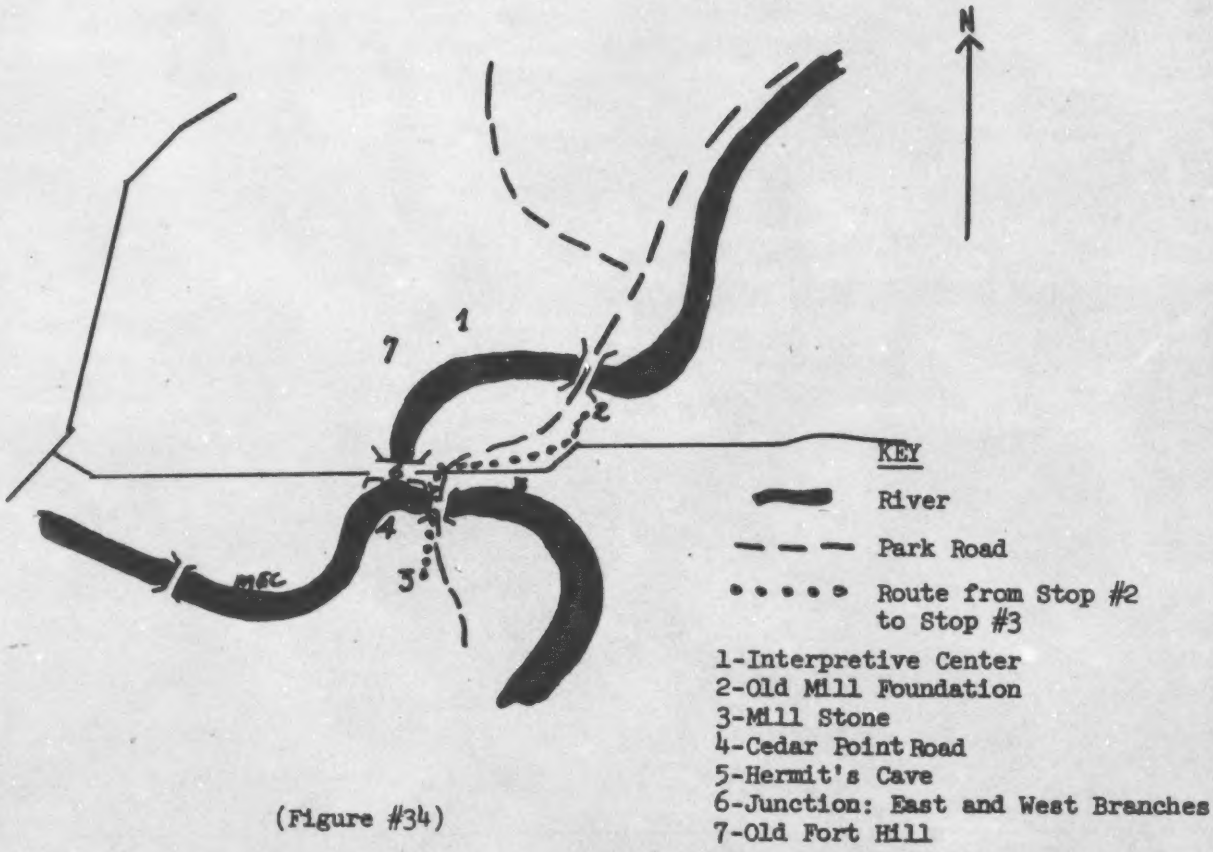


Map of Area
(Figure #33)

The old river crossing (1) at the foot of Stranahan Hills was considered the most hazardous crossing of the entire Rocky River. Remnants of this old Lorain Road are still visible at the southern end of the bike trail, opposite the present bridge. Descent was from Coe Ridge (Lorain Road), down Stranahan Hill, crossed the river at approximately where the present bridge is located, and came up near Fairview Park Hospital. In 1895, the new high level bridge over the valley eliminated the steep hill and old road. Up to this time, the Detroit bridge was the only high level bridge over Rocky River. (The present high level Brookpark bridge was dedicated in 1934.)

William J. White, the "Bubble Gum King" and maker of Yucatan Gum, was also the owner of this lovely section of the valley. Part of both golf courses, Little Met (2) and Big Met (5), were a portion of his stock farm. The horse barn (4) is still in use and is now housing a section of the Western Division Maintenance Headquarters. His villa was up on the archery range (3). The W. J. White Farm was nicknamed the "Two-Minute Farm" in 1905, when White's horse, Star Pointer, became the first horse to run a mile in two minutes.

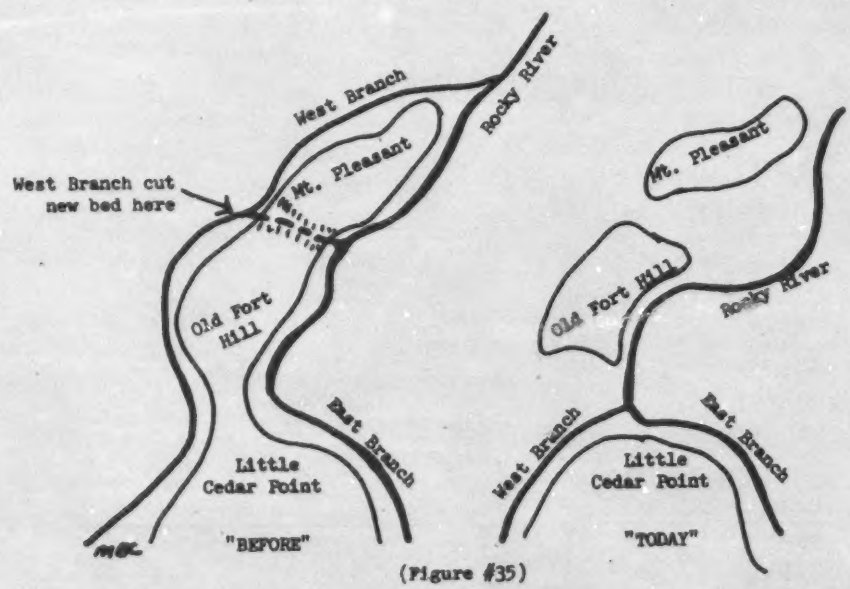
INTERPRETIVE CENTER TO LITTLE CEDAR POINT



(Figure #34)

As you take the walk along the river from the Interpretive Center to the parking lot, you can observe the results of the three geological phenomena that affected the area -- layered soil of the seas, glacial erratics carried here by the glaciers, and the valley in the process of being cut by the river. Also, standing very firmly and defiantly in the river is a flood plain island in the process of being developed. The vegetation indicates the island has existed for a long time. Fifteen years ago, during the dry season the island could be reached by walking from the flood plain on the south side of the river, across a then-dry gully, and onto the island. Notice how the river acts as it rolls past the island. The river tends to erode the west end of the island, but as an eddy develops, the eastern end builds. In comparing the vegetation of this island with the island developing in the river at Scenic Park, we note the cottonwoods, sycamores, locust, and willows are more mature than the young growth on the Scenic Park island. River conditions are quite different, too--fast stream vs. riffles, curved riverbed vs. straight bed upstream.

Stream piracy! A study of the former riverbed of the Rocky River West Branch has led to some fascinating theories. The steep wall carved to the west, the three hills separated by low areas, and the presence of bog iron make these ideas feasible. Walk through this area to determine if you agree with these conclusions but remember the river has had only 12,000 years in which to accomplish this work.



(Figure #35)

Little Cedar Point obtained its name from the stand of cedar trees that grew atop the high bluff that comes to a point at the junction of the East and West branches of the Rocky River. The cedars went down with the erosion, much as the industry and family life of Little Cedar Point have vanished with the changing times. The cedars have been replaced with a stand of pines. Industry and homes have been replaced with a scenic park and recreational space.

Cedar Point crossing was a ferrying point on the east-west Indian trails. It was surveyed and marked as a county road around 1820. The present Cedar Point Road is a gradual slope compared with the steep hills forming it in the olden days. Then Cedar Point hill was the test strip for practically all the different makers of cars. A person's decision whether or not to buy a certain car was decided by the Cedar Point hill test ride. If a car could climb the hill without shifting into low gear, it was considered a reliable buy.

Evidence that Little Cedar Point and Old Fort Hill were inhabited by Indians has been found. Ruins of an old wooden fort were atop Old Fort Hill. It is not known whether it was built by Indians or by very early settlers; however, arrowheads, stone hatchets, and flint skinning and scalping knives, plus other Indian relics have been found there. At Cedar Point area, up on Ruple Road, arrowheads and other Indian weapons of war were uncovered by Robert V. Gray as he farmed his land. Colonel James Smith, one of the first white men held captive by Indians in 1755, wrote about the winter encampment "in cabins of log and animal pelts" along Rocky River. The area he described could be Little Cedar Point valley (settlement name was Cedar Valley) or Mastic Valley. So Indians weren't just camping at the mouth of the Rocky River but did travel quite a distance upstream. The Indians left the area around 1812 and, only occasionally, would an Indian be seen after that.

The settlers found water power for their mills and rich alluvial soil for their crops in this area. There was fishing in the streams and hunting in the woods. Sawmills and gristmills were in Cedar Valley. Through the years, their

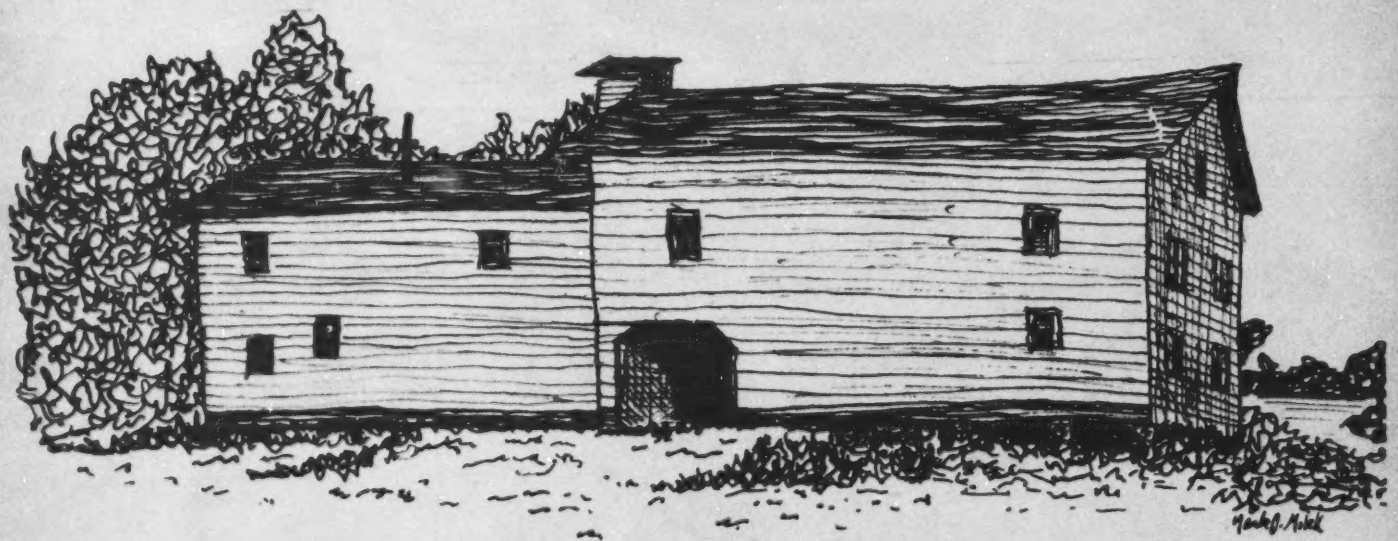
ownership and partnerships transferred. In 1819, Lemuel Hoadley built a sawmill on one side of the river and a gristmill on the other. Harry and John Barnum and Buel Peck, owners of a sawmill and gristmill, tried to "beat" the high cost of shipping their lumber to Cleveland. The valley roads were steep and the Cleveland roads were bad. Hauling lumber to Cleveland was absorbing all of their profits. The men built two rafts with about one hundred thousand feet of lumber in each. They rafted the lumber down the Rocky River. The lumber became jammed at a dam but suddenly broke loose. The speed of the current was so great that all efforts to save the lumber were to no avail. The lumber went sailing out into Lake Erie. Canoes enabled the men to reach shore.

Lumbering was a basic industry of Cedar Valley. Giant white oak, beech, and black walnut trees were needed for houses, barns, and sheds; chestnut was split for fence rails; ash, hickory, and ironwood made wagons and farming implements. Lumber for railroad ties and plank toll roads was also required.

Grist and flour mills held equal importance with sawmills. Joel Lawrence started a gristmill in 1832. He built a dam on the east branch of the river. He then made a wooden sluice under the road to direct the water to the wheel. The old stone foundation lies just east of the park road and southeast of the ford by the Interpretive Center. This is the only mill in the valley where you can trace the site of the dam, the mill race, and the mill foundation stones.

Joel Lawrence Dam
(Figure #36)

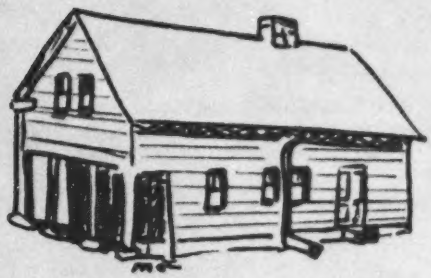
Joel Lawrence started the mill; during its 75 years of operation, it underwent a series of different ownerships. During George Thomas' ownership a fish ladder was built into the dam, enabling the fish to make their way upstream to spawn. The flood of 1913 wrecked the water wheel so the then-owner, Servillion H. Fish, decided to replace it with a gasoline engine. Unfortunately, he collapsed and died on his way to Cleveland to get the engine. In 1917, the old mill became unsafe and the owner, Albert Laisy, had it torn down.



Joel Lawrence Grist Mill
(Figure #37)

The Prechtel House, between Lewis Road and the bridge on Cedar Point Road (built in 1876) is the oldest remaining house in Cedar Point valley. It is a good example of farmhouses of that period. The Olmsted Historical Society uses the Prechtel House for their Frostville Museum. The name "Frostville" was chosed for the museum in honor of the first post office (1829) in Olmsted Township (Elias Frost was the first Postmaster).

The Prechtel House
(Figure #38)



Brigg's House:: One of the Oldest Houses in North Olmsted (Figure #39)

The Briggs House, which stands next to the Prechtel House, was moved here from Lorain Road because it is considered one of the oldest houses in North Olmsted.

These houses are open for viewing on Sunday during the summer. Call the Olmsted Historical Society for exact dates and times.

One would think that it was the unreliable and diminishing water power that caused the valley industries to finally change from water power to the more dependable steam power and combustion engines. Ironically, it was over-abundance of rushing water that was the deciding factor in the abandonment of mills along the Rocky River. The floods and high waters were uncontrollable. They damaged crops, routed people out of homes, and destroyed equipment and belongings. Many times, when the ice broke up in the early spring thaws, the entire valley looked like a huge lake or ice field.

When the Little Cedar Point lands were acquired in 1924, sawmills and grist-mills were no longer operating; however, the old steel bridge with a plank board bed was still in use. The Cleveland Shale on Little Cedar Point was not nearly as eroded as it is today. At that time, the Point could be touched with a wooden cane while the person was standing on the bridge.

Fossils in the black Cleveland Shale are extremely difficult to find and even more difficult to assemble, once they are found. During the early days several men had "fossil fishing" in Cleveland Shale as a hobby. Dr. Clark is the man who evidently did the most "fossil fishing" with success around Cedar Valley. Fossil sharks and armored fish have been found upstream along the West Branch. Also, "cone-in-cone" structures can be found in narrow limestone concretions squeezed between layers of Cleveland Shale.

LAGOON AND ANTICLINE

A man-made oxbow? Rivers make oxbows naturally -- they only require more time than man does. Ice would form around this oxbow type bend. Then, with spring thaws, the flows would break free and rush with tremendous hammering speed downstream. At the next major curve, they would hit the shale bank. The impact was so great that the vibration could be felt on Ruple Road. To protect the road a plan was conceived which would also add to the recreational advantage of this area -- build a lagoon. The extreme ends of the oxbow were dammed. An inlet to control the flow of the water into the lagoon was placed at the upper end. A spillway carrying water under the road and back into the river was located at the lower end. A man-made trench was dug to carry the regular river flow. There is a dam and control wheel in the river, opposite the upper end of the lagoon. This provides control on the amount of water flowing downstream and allows for raising the water level in the river high enough so water could be fed into the lagoon.

Approximately one hundred paces west of the road on the north side of the lagoon bank is an anticline. This anticline is clearly defined even though there has been much erosion through the years.

This area seems uncomplicated, but it does contain some mysteries:

> Why is there just a single anticline without the other layers appearing to be disturbed?
>
> Is any part of this anticline visible anywhere else in the valley?
>
> How did the boulders, apparently erratics from the glacier, become embedded in layers left by the seas?
>
> Why are these boulders protruding from the bank?
>
> Next, why does the lagoon water seem so polluted when the water flow control units are constantly moving the water to the river?

The lagoon shelter house is constructed of huge sandstone blocks from a railroad bridge of the Lake Shore Railroad just north of Berea. The stones were probably cut from the Berea quarries when the bridge was built about one hundred years ago.

BEDFORD SHALE: SLEDDING AREA

The geological features across the river at the foot of the sledding hill are worth the trek down and the long climb back. A delta resulting from streams flowing from the north deposited sediments that later formed the Bedford Shale. A period of minor uplift caused some folding and tilting which left the present Bedford Shale with this pattern. Because the layers above and below the Bedford Shale seem undisturbed, some people believe that mud slides occurred during various stages of the deposition of the sediments. At present, either theory is accepted. Scientists need to uncover additional clues revealing more exact information.

The flat area, about fifty paces upstream, has a different kind of deposit -- cornerstones from grindstone wheel blanks. The flat area would accomodate stone cutting. The speed of the stream would provide the power. But where did the stone blanks for the grinding stones come from? Were they hauled here? Or, perhaps the cutting was accomplished farther upstream and the swift currents carried the corners to this location. If so, why did they stop here instead of being washed farther downstream? No industries of this type appear to have been located north of the Berea quarries. A few yards upstream, Berea Sandstone outcroppings appear. If the grindstone was shaped here, why is there no record?

THE "POTHOLES" AND FALLS

The Berea Sandstone falls area is not only fascinating for its interesting assortment of rocks tumbled at various angles; its riverbed of tremendously large flat sandstone; its deep potholes that have been drilled by water power; but also, its parade of industries that capitalized on the natural power found in the falls.

Ephrim Vaughn and his sons had the first two sawmills and gristmills in Middleburg Township -- one at the present site of Berea's waterworks and the

other at the "falls".

The natural water power provided by the falls stimulated a succession of industries. Just above the falls were Eli Osborne's carding and fulling mills. He built a dam to control the water power, but the tremendous onslaught of water in the spring of 1833 destroyed Osborne's dam and mills.

Tilden Iron Foundry followed Osborne's mills. Bog iron found in Middlesburg was fashioned into cast iron kettles, household utensils, and cast iron plow shares. Fairchild's wooden bowl factory produced thousands of bowls, plates, and wooden ware which were sold in the eastern and midwestern states. Farther downstream, where Spafford Road crosses the river, woolen cloth was made by the Hollowell family.

Falls are formed where at least two different rocks of varying hardness are layered. The softer rock is eroded, and the harder rock becomes the lipstone for the falls. As the underside of the lipstone undercuts the lipstone deeper, the lipstone falls away to become just a rock in the stream; and a new lipstone for the falls is formed.

CREDITS

Pictures, maps, and diagrams help a book to be better understood. We are grateful to the following sources which have given written permission to use drawings and adaptations of drawings from works they have published. This cooperation and generosity is appreciated.

(M. E. C.)

Figures 20, 21	Cleveland Metroparks, Department of Interpretive Services
Figures 1, 2, 3, 4, 5, 7	LaRocque and Marple, Ohio Fossils, Ohio Division of Geological Survey, Columbus, 1959
Figure 9	Richner, Donald R., The Geology of Northeastern Ohio, Diamond Alkali, Cleveland, 1958
	Cleveland Museum of Natural History
Figures 8, 10	Forsyth, Jane E., "Ohio's Coldest Winter," The Explorer, Volume 5, No. 4, July-August, 1963
Figures 22, 23	The Explorer, Volume 6, No. 4, July-August, 1964
Figures 12, 32	Williams, Arthur B., Geology of the Cleveland Region, Geological Series No. 1, 1940
Figure 6	Ibid., with credit to Schurchert and Dunbar, Textbook of Geology, Part II

SUPPLEMENT A

STUDENT WORKSHEETS

Project ENRICH
Rocky River City School District
January, 1976

Student's Name_____

Teacher_____

School_____

Student Group Number_____

Date_____

STUDENT WORKSHEETS

A ROCKY RIVER VALLEY STUDY - CLEVELAND METROPARKS

Instructions for Everyone

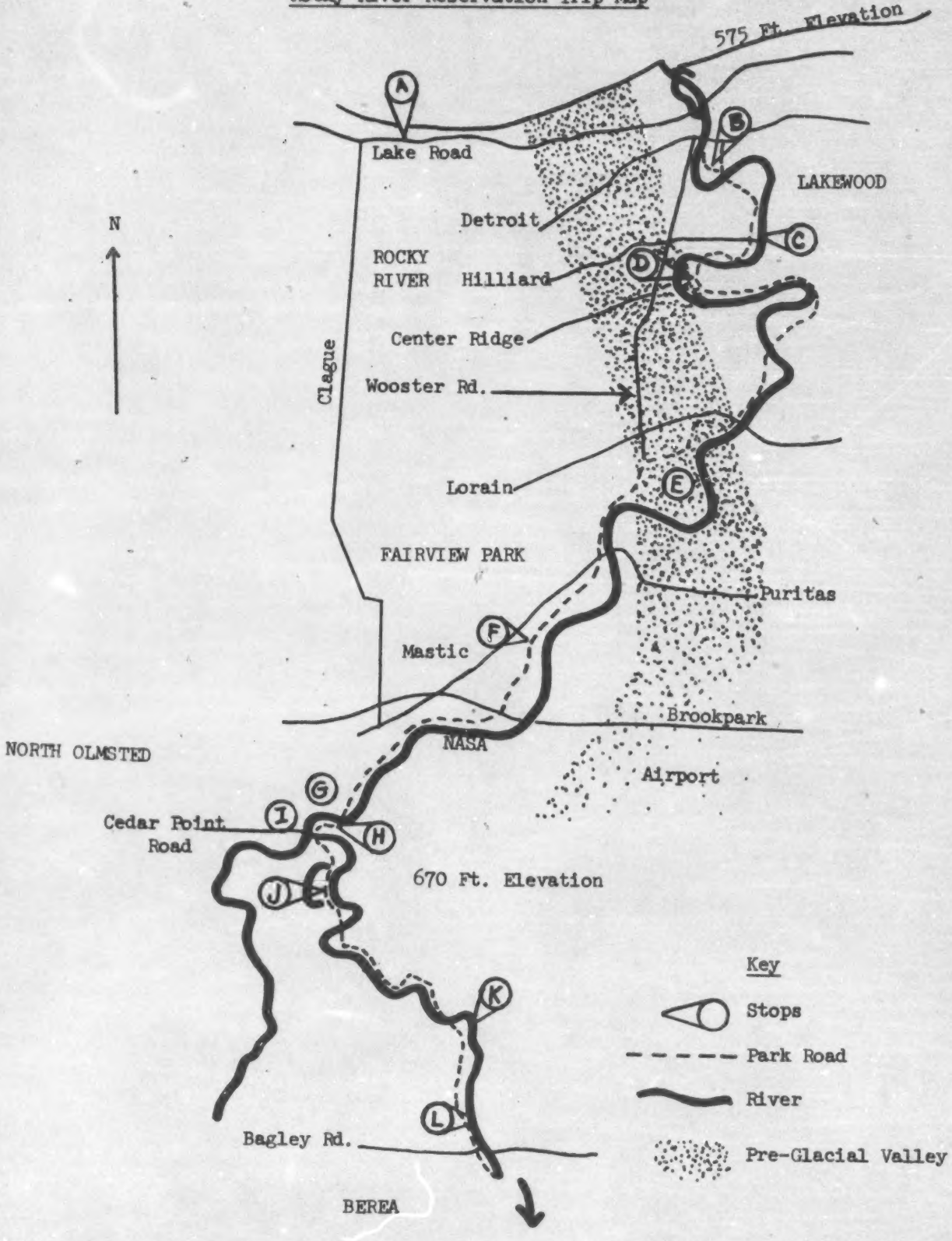
You are about to embark on a journey into the past and the present. As you proceed through the valley, take time to observe and ponder. Your eyes will be opened to the wonders around you. The many millions of years required to build this glorious mud pile are awe-inspiring.

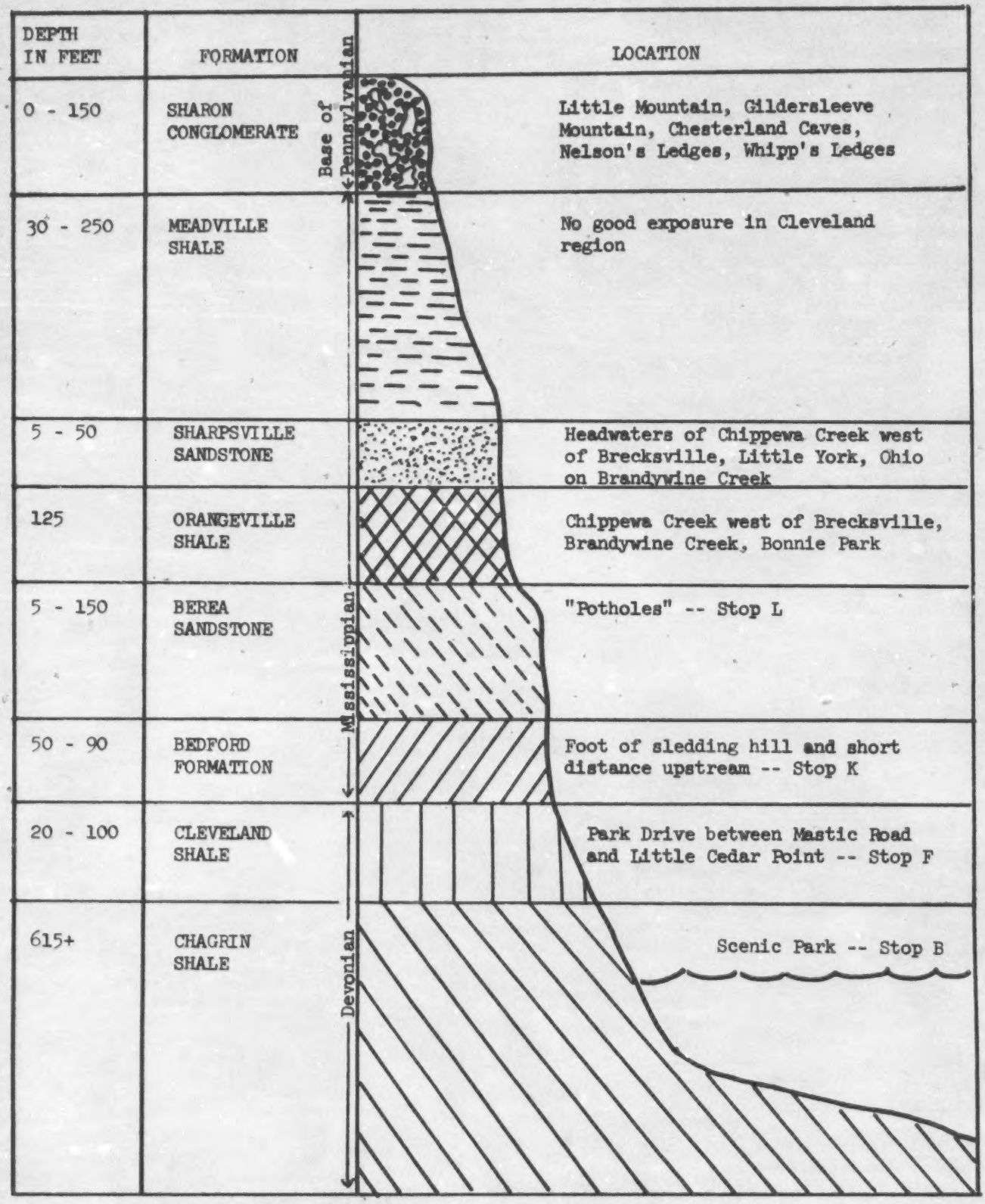
Everyone, students and leaders, will have a happy, informative, fun-filled trip if these simple guidelines for safety and courtesy are followed.

Rules of the Road

1. Stay with your group leader at all times. This includes never getting ahead of him/her as your group moves from place to place.
2. There must be no rock throwing, running, shoving, pushing, etc.
3. Place all your litter in the proper receptacle.
4. Stay out of the water.
5. Give all cars the "right of way."
6. Do not get unnecessarily dirty. Clean your shoes before re-entering the bus.
7. When walking through wooded areas, hold onto branches until the person following you has grasped them.
8. Do not pick, damage, or remove anything from the park.

Cleveland Metropark
Rocky River Reservation Trip Map





ROCK EXPOSED ABOVE LEVEL OF LAKE ERIE

When formation can be viewed on the Rocky River Metropark trip, only that location is listed. (Chart adapted from Arthur B. Williams, Geology of Cleveland Region)

STOP A: THE PIER

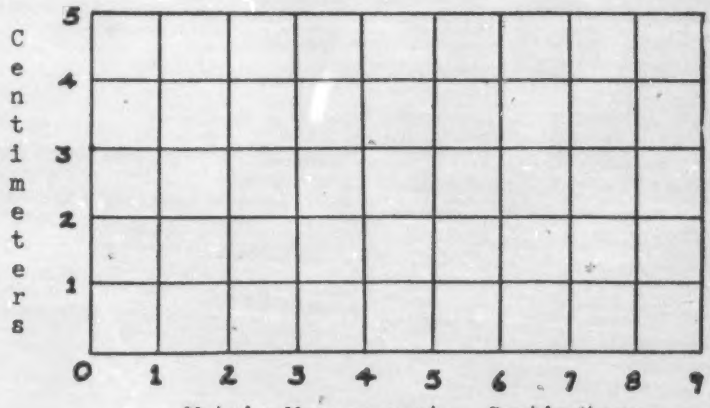
Time Allotted: 40 minutes

Instructions:

The major attraction of this stop is the search for fossils. A hand lens is a handy tool for identification. You will find that dipping the stones in water makes them easier to read. If the fossil search is preceded by a simple rock classification session, many unnecessary questions can be eliminated. Have students pick up "interesting and different" stones and place them in one of three classificiations -- natural stones, glass, and man-made other than glass; then proceed with the fossil hunt.

The entire search should take approximately thirty minutes. Competition between groups, (or girls vs. boys) may spur students to more enthusiastic and accurate searching. The remaining ten minutes should be devoted to the other activities listed for this stop. Please remind the students to refrain from skipping stones and to stay out of the water.

Challenges:



Metric Measurement - Centimeters

1. How many fossils did your group find? _____

2. Write the dimensions of your largest fossil. _____

3. Write the dimensions of your smallest fossil. _____

4. Using your compass, locate due North. Where is it in relationship to the pier?

_____

Points to Ponder

1. Why do you suppose these fossils are in this area? Remember that this area was covered by inland seas, leaving many layers of shale and silt-stone. These fossils are not native to such formations.

2. How did this particular area become open space near to the shoreline? Note that the shoreline east and west of the pier is steeply banked.

Additional Observations:

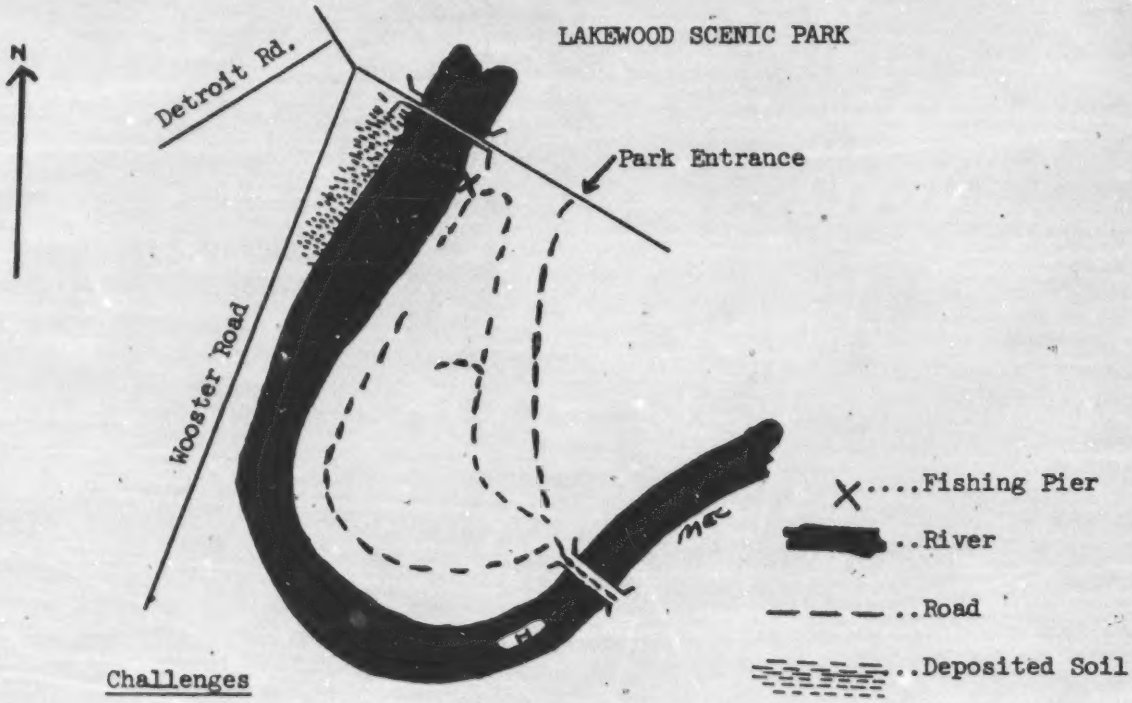
Place additional observations on back of this page.

STOP B: SCENIC PARK

Time Allotted: 40 minutes
For Additional Information
See Pages 24-30

Instructions:

Park the school bus in the parking space next to the edge of the river and just north of the boat ramps. Begin the tour at point "X." Walk southward along the edge of the river, noting features listed under "Challenges." After finishing the walk, have groups sit at picnic tables or on the ground to complete challenges. If it is winter and cold, complete the work on the bus.



Challenges

1. Identify the following points on the map by writing the letter on the map at the correct location.

A. Private Land Deposited During the Past Fifty Years
B. Chagrin Shale Exposure
C. Retaining Wall
D. Talus Slope
E. Sandstone and Siltstone Intrusion
F. Fast Side and Slow Side of River - Beware of Wind Effect
G. Stream Riffles or Shallow Rapid
H. Flood Plain Island in Formation

2. Identify the various uses of a flood plain as evidenced here at Scenic Park. Place the letter on the map as you have them listed.

a - _____ d - _____

b - _____ e - _____

c - _____ f - _____

Points to Ponder:

1. By counting the major deposition lines on the valley wall, estimate how many seas entered this area. _____

2. How did this flood plain increase in width?

_____

Is it continuing to grow? _____

What is your evidence? _____

_____

3. Can Wooster Road be saved from erosion? How? Or why not? _____

_____

_____

_____

4. How can you tell that Scenic Park is built on a mature flood plain? _____

_____

_____

_____

5. One valley wall (west) is steep and sheer. The other (east) has a gradual incline. Why? _____

_____

_____

Additional Observations:

_____

_____

_____

_____

_____

_____

STOP C: HILLIARD/I-90 BRIDGES Time Allotted: 15 minutes

Instructions:

Here is an opportunity to observe changes caused by nature and man-made changes. Since time is limited, groups should be divided so that one-half of the students identify changes caused by nature, and the remaining students should note man-made changes.

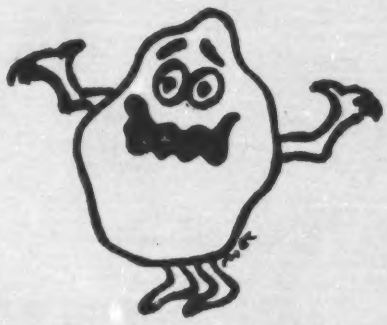
Challenges:

Place an X before the changes you have been assigned to observe.
_____ Changes Caused by Man
_____ Changes Caused by Nature

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____

Points to Ponder:

1. Will the vegetation under the bridge continue to grow. Why? Why not?
2. What causes the color of the run-off from the storm sewer on the east side of the river?
3. Are the bridges affecting the shapes of the trees. How?



Additional Observations:

Place any additional observations on the back of this page.

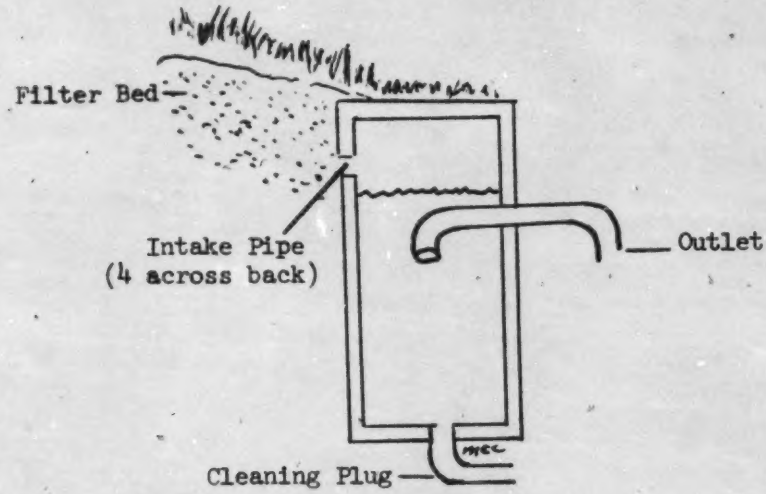
STOP D: ROCKCLIFF SPRING/MEMORIAL BALL FIELD

Time Allotted: 40 minutes
For Additional Information
See Pages 31-35

Instructions:

This is another fascinating "walk through" area. The points of geological and/or social history have been identified by letter on the map of the area. At one time this was a small community of homes, blacksmith shop, grist mill, stage coach house, and inn. The spring's natural outlet was near the top of the hill and to the north of Rockcliff Road.

The area can be found quickly as there is a slight depression on the earth's surface and the skunk cabbage grows in profusion in the wet areas. In early days, the Gasser Greenhouses obtained the water for the orchids from this spring. (The greenhouses extended from Wooster Road to Gasser Street.)



Holding Tank

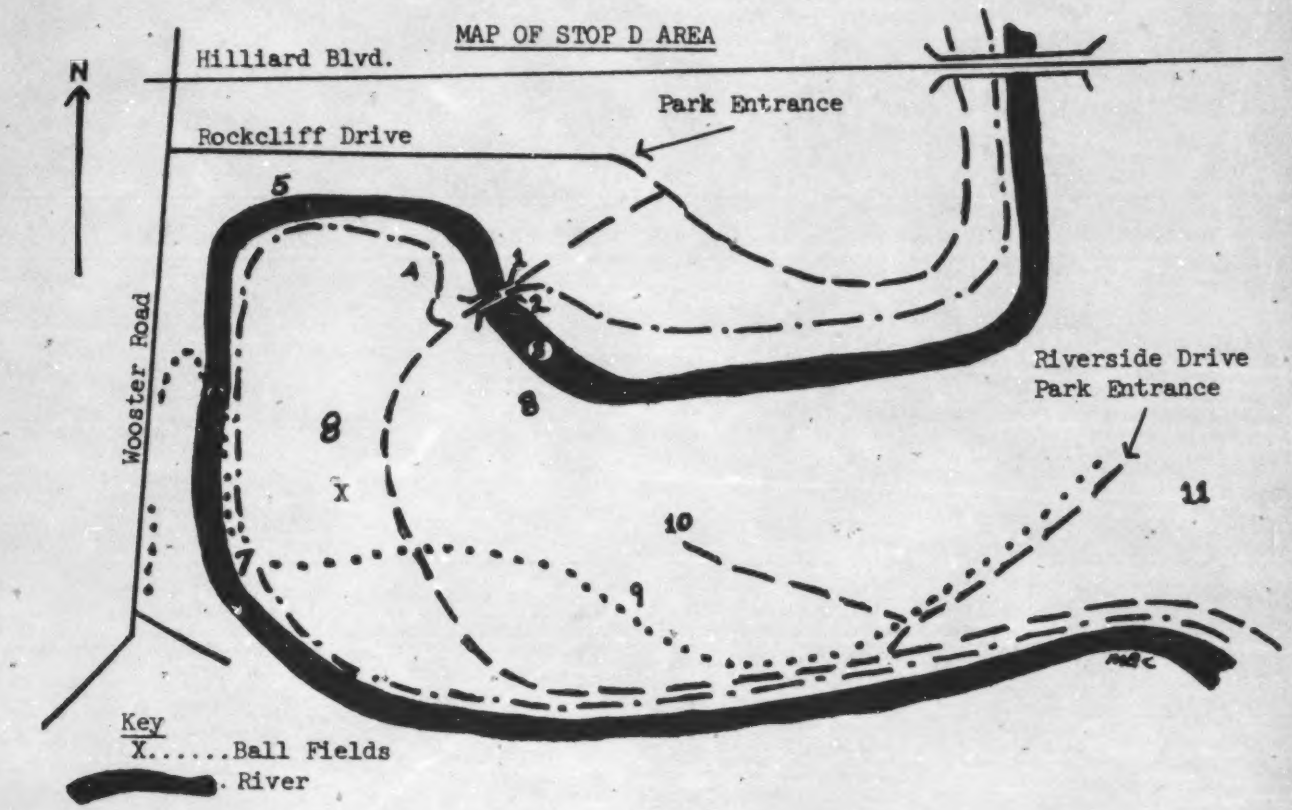
A 4 foot X 4 foot X 8 foot tank holding 500 gallons is located about half way down the hill and to the northwest of the present spring outlet. The spring yields approximately five gallons of water per minute. Although the water is generally pure, the warning sign indicates that at times the water may contain slightly more contamination than the State Department of Health allows for drinking water.

Other points of interest are identified on the map. Traces of the blacksmith shop and some homes have been erased over the years; however, with careful observation, evidence of other past history can be found.

Weber's Hogback Road has been eroded along Wooster Road, but it is again discernible near Center Ridge Road. This road is believed to have followed Indian trails across the valley and to have been one of the earliest improved roads in the valley.

STOP D: ROCKCLIFF SPRING/MEMORIAL BALL FIELD (Continued)

MAP OF STOP D AREA



1. -- 500 Gallon Holding Tank
2. -- Spring Outlet
3. -- Natural Gravel Ford
4. -- Site of Blacksmith Shop
5. -- Pre-glacial Valley
6. -- Bridge for Weber's Hogback Road
7. -- Gristmill
8. -- Approximately 12 Homes in "8" Areas
9. -- Stagecoach House
10. -- Stinchcomb Monument
11. -- Idlewild Tavern

STOP D: ROCKCLIFF SPRING/MEMORIAL BALL FIELD (continued)

Challenges:

Write the evidence that indicates each of the following existed. Use the map of the area as a guide to the locations.

1. Natural Gravel Ford (#3 on map) _____

_____

2. Pre-glacial River Valley (#5 on map) _____

_____

3. Weber's Hogback Road Bridge (#6 on map) _____

_____

4. Gristmill (#7 on map) _____

_____

5. Site of Stagecoach House (#9 on map): Do this activity only if it is winter when there are no leaves on the underbrush. _____

_____

_____

Points to Ponder:

1. Why does this flood plain have such sandy soil?

2. The glacial till is very porous. Since glacial till fills the pre-glacial valley, how is the water that is trapped in this till directed to Rockcliff Spring's holding tank?

Additional Observations:

_____

_____

_____

_____

_____

_____

STOP E: "BUBBLE GUM KING" AND "TWO MINUTE-FARM"

Allotted Time: 0 minutes
For Additional Information
See Pages 36, 37

Instructions:

There is no time on this trip to explore this stop; however, it does have an interesting history. As the bus approaches the bridge leading to "Little Met" Golf Course, have the students look at the map and share this information.

The pre-glacial valley transversed this area. Thus, when the present Rocky River cut its new bed, the glacial till eroded more readily and left this wide open space. It was the farm of William T. White, "Bubble Gum King" and maker of Yucatan Gum. The two golf courses were a part of his stock farm. His horse barn (still standing) now serves as part of the building, housing the Western Division Maintenance Headquarters. The "Bubble Gum King's" villa was on the upper part of the archery range. The W. J. White Farm was nicknamed the "Two-Minute Farm." In 1905 White's horse, Star Pointer, became the first horse to run a mile in two minutes.

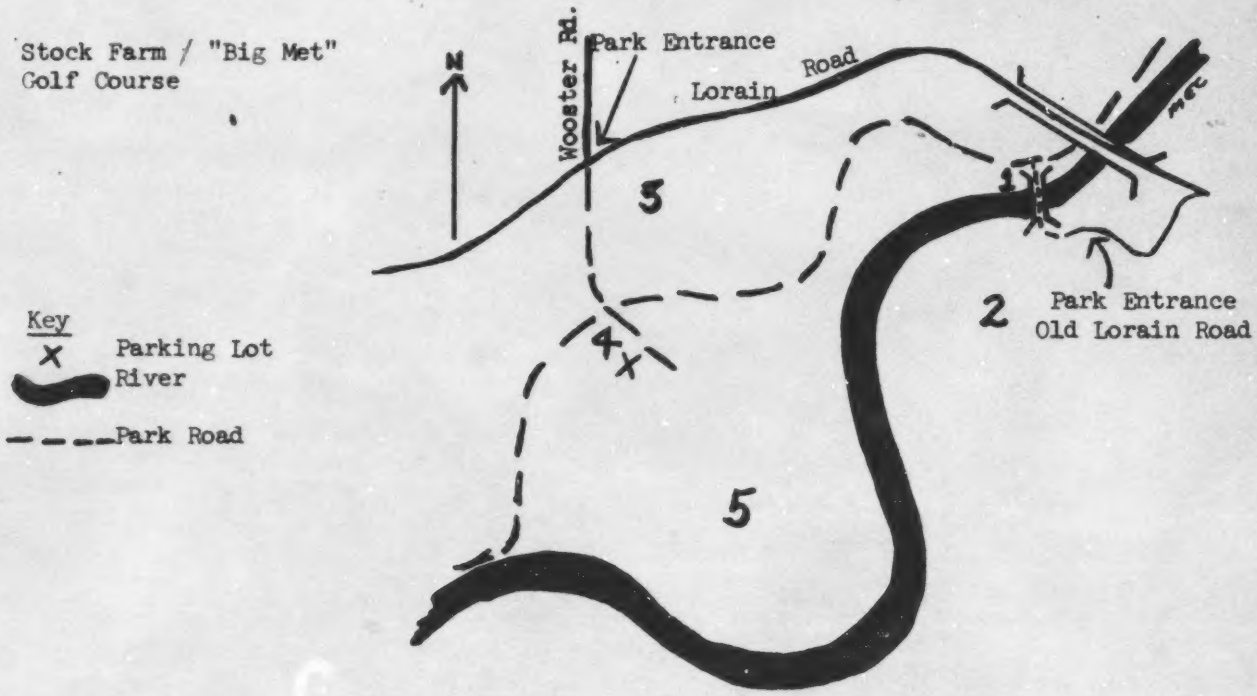
1. Old river crossing which was supposed to be the most hazardous crossing of the entire Rocky River.

2. Stock Farm / "Little Met" Golf Course

3. William T. White Villa / Archery Range

4. Horse Barn / Maintenance Headquarters

5. Stock Farm / "Big Met" Golf Course



STOP F: CLEVELAND SHALE BANK Allotted Time: 5 minutes

(Located on northwest side of road between Mastic Road and Little Cedar Point.)

Instructions:

This is the first major outcrop of an entire bank of Cleveland shale that we have encountered thus far on this trip. Here the students have the opportunity to touch and see closely, both weathered and non-weathered Cleveland shale.

When first exposed to the atmosphere, Cleveland shale is black; but it soon weathers to reddish-brown or gray and breaks up into thin, sharp-edged, slaty fragments. Fossils in Cleveland shale are scarce except at certain locations. Note the angle of talus slope.

Additional Observations:

STOP G: INTERPRETIVE CENTER Time Allotted: 45 minutes

Instructions:

Before leaving the bus, reminders must be given. No one may get ahead of his leader on the walk to the center. This includes entering the Interpretive Center ahead of his/her group leader. Only ten students (five boys and five girls) may enter the lavatories at one time.

After the student has been to the lavatory, he/she may begin the "Challenges." Running and unnecessary loud noises are not considered acceptable behavior. This is a work area and should be enjoyed by everyone in the building.

Challenges:

Inside the building: Answer the following questions as you study the exhibits.

1. What carved the Rocky River Valley?

   _____

   _____

2. How many times has ice covered much of the Northern Hemisphere? _____

3. What is the name of the last ice advance? _____

4. How long ago did the last ice advance end? _____

5. What is the name of the large armored fish? _____

6. How long ago were such fish swimming here? _____

7. How many different rock samples are on display? _____

8. Identify the oldest rock layer that is exposed in the Rocky River Valley. _____

   _____

9. Identify the youngest rock layer exposed in this valley. _____

10. During which geological period was Ohio partly covered by a sea?
    Mississippian - Pre-Cambrian - Devonian? _____

"Adapted from Rocky River Reservation Trailside Interpretive Center materials, courtesy of the Cleveland Metroparks - Dept. of Interpretive Services"

Project ENRICH - Title III

STOP G: INTERPRETIVE CENTER (Continued)

Outside - on the porch:

Answer the following questions based on your observations.

1. What evidence can you see that proves that water has power?_____

2. Three distinct geological events affected this area. What evidence proves that each was present?

   Seas?_____

   Glaciers?_____

   Rivers?_____

3. Why isn't the area beautified by removing the dead, fallen trees?_____

4. How do you suppose the porch is supported so that it does not fall into the river?_____

Additional Observations:

Time Allotted: 40 minutes
For Additional Information
See Pages 37-42

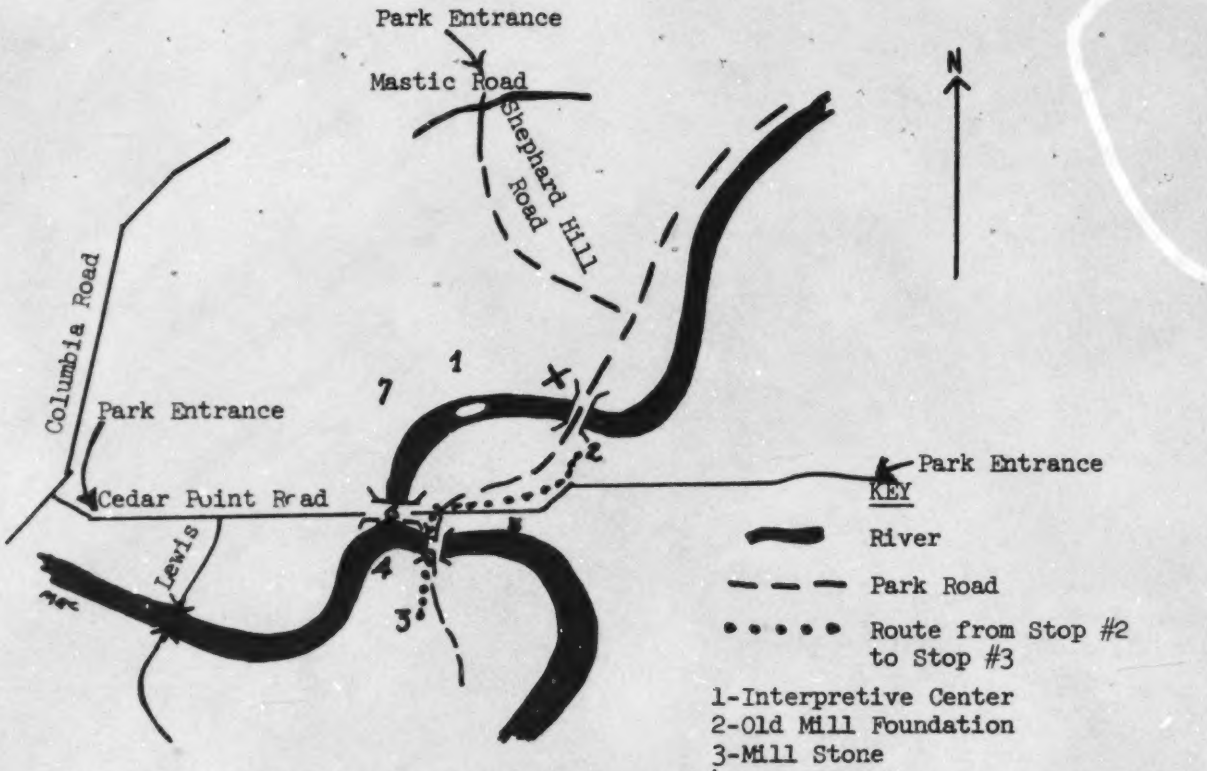
STOPS H AND I: OLD MILL, LITTLE CEDAR POINT, HERMIT'S CAVE, AND JUNCTION OF EAST AND WEST BRANCHES OF RIVER

Equipment Needed: Magnetic Compass
Measuring Tape
Painted Tongue Depressors (2)
(one red and one white)

Instructions:

There are several points of interest with romantic history in this area. The map will aid you in moving from one point to the next. Traffic will be hazardous so remind students they are not to get ahead of the leader.

As you leave the Interpretive Center (1), proceed to the Old Mill Foundation (2). It is located left of the road leading to the ford that runs parallel to the bridge. When the activities are completed at the mill site, new instructions will be given that will direct you to the next point of interest.



Project ENRICH - Title III

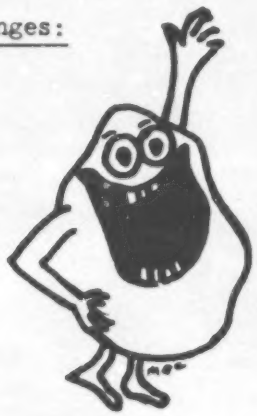
STOPS H AND I: (Continued)

This mill, known as the Joel Lawrence Grist Mill, was constructed about 1832 and continued in operation until about 1913. It is the only mill in the valley where you can trace the dam, the mill race, and the mill foundation.

The dam section is evident on the north side of the Maple Grove picnic area. The water was taken from the East Branch, tunneled under Cedar Point Road to the mill race, through the mill, and returned to Rocky River.

This was a thriving little community. Besides the gristmill, a children's home, a wooden bowl factory, a maple syrup house, and farms were located in or adjacent to this area. Frequently spring floods drove the settlers out of the valley, but they returned when the water receded.

Challenges:



1. What evidence is there that the mill was destroyed a number of years ago._____

_____

_____

2. Do you suppose the water passed over or under the wheel?_____ Why?_____

_____

3. Does the location of the sluice influence your decision?_____

4. Why haven't the foundation stones weathered away or been rearranged by heavy storms?_____

_____

5. What was the path of the water after it passed the mill?_____

_____

Points to Ponder:

1. From where did the foundation stones come?
2. How were they transported?
3. Why did the mill cease operating?

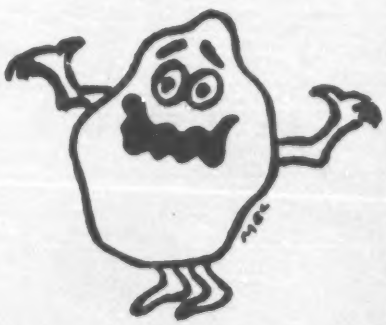
Additional Observations:

_____

_____

_____

_____



STOPS H AND I: (Continued)

Instructions:

Follow the dotted line on your map along the path, south across the ford, to point (3). This point of interest is hidden among the trees west of the park road and just south of the bridle path. To help you in your identification of point (3), the object we are looking for has a square hole at the center.

Challenges:

1. What is this object? _____

2. Measure and record the diameter. _____

_____

3. How did it get here? _____

_____

4. Why is it still here? _____

_____

Additional Observations:

_____

_____

_____

_____

_____

Challenge For Interest Points on Map:

1. Take a compass heading of 65° from point (3).

2. Walk at that heading until you reach the river. If you used your compass correctly, you should now be opposite Hermit's Cave.

3. How accurate were you?

STOPS H AND I: (Continued)

Points to Ponder:

1. How does Hermit's Cave relate to the mill?
2. How was the tunnel constructed without the advantage of modern machinery?
3. How were the top stones (key stones) put in place and what holds them up?
4. How do you know that the tunnel has been here for a long time?
5. How did the water get from the river into the cave?
6. How was the flow of water controlled?
7. Find evidence that a dam was at this site.

Additional Observations:

STOPS H AND I: (Continued)

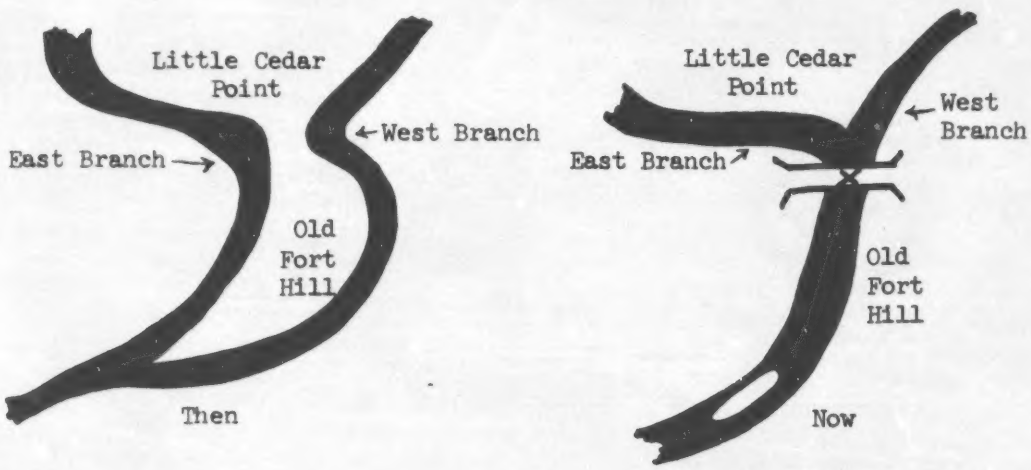
Instructions:

Walk along the path near the river, cross the ford to the bridge (6) on Cedar Point Road. This is where you will use the painted tongue depressors to solve some of the challenges. Fossil sharks and armored fish have been found in the Cleveland Shale upstream from the bridge and along the West Branch.

Challenges:

1. Which branch of the river is dirtier?_____
   Why? _____
2. Which branch travels faster at this point?

   _____Using the tongue depressors, can you prove which branch is traveling most rapidly?
3. Stream piracy -- which branch won? _____ (See page 38.)



"Adapted from Drawings by Mr. Donald Altemus, courtesy of the Cleveland Metroparks Dept. of Interpretive Services"

Points to Ponder:

1. How old is the bridge?
2. How is the volume of the flow of water measured? (Approximately 163,000,000 gallons of water per day flows past the Interpretive Center.)
3. Old Fort Hill is considered a "naturally made" defense area. Indians, in many parts of the country, used these triangular, steep-walled, high platforms for defense by digging trenches across the narrow point of the triangle. If defeated at one trench, they would move back to the next trench. Their enemy could get trapped on the point. Was Old Fort Hill used in this manner for defense?
4. How was the hogback of Old Fort Hill formed?

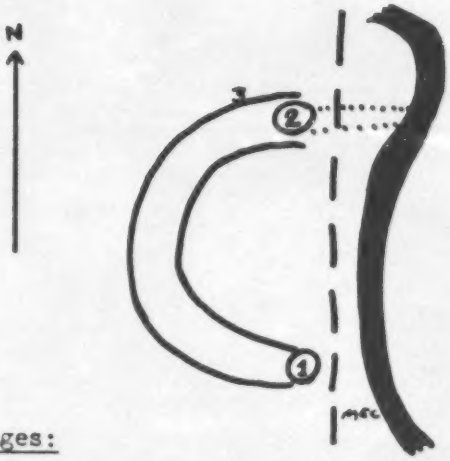
Additional Observations: Place any additional observations on the back of this page.

STOP J: LAGOON

Time Allotted: 10 minutes
For Additional Information
See Page 43

Instructions:

This is a man-made oxbow. Originally the river flowed where the lagoon is now located. Now the river flows along the man-made trench and the original river is dammed. The lagoon was built for two purposes -- to develop a swimming and boating recreational area and to prevent damage from ice flows pounding against Ruple Road.



KEY

River

Lagoon

----Park Road

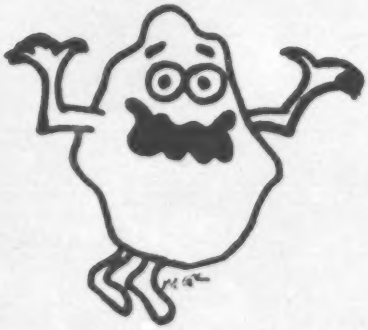
.....Outlet to River

1-Water Inlet
2-Water Outlet
3-Anticline

Challenges:

Draw a sketch of an anticline in the space below.

Points to Ponder:



1. What caused the anticline?
2. How is the flow of water controlled in the lagoon?
3. Has the lagoon served the purpose for which it was constructed?
4. In looking at the cross section of soils, why is there such a difference between the high perpendicular bank and the low land?
5. How did the protruding boulders get buried in the soil?
6. Why does the water have such a color?
7. Is the anticline exposed downstream?

Additional Observations: Place on back of page.

STOP K: BEDFORD SHALE

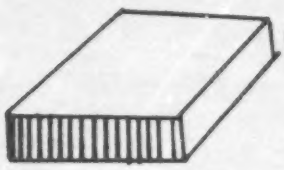
Time Allotted: 25 minutes
For Additional Information
See Page 44

Instructions:

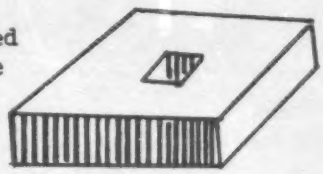
Walk down the hill, or go down the steps to the right of the hill; then proceed upstream about 50 - 75 paces. The opposite river bank is composed of Bedford Shale. Originally, the sediments were laid down in parallel layers; but, with the earth's processes causing folding and uplifting, the layers are no longer parallel. This Bedford Shale is an excellent example of minor diastrophism.

Corners of Berea Sandstone slabs which remained after grindstones were made can be found in this area. The following diagrams show how such grindstones were originally cut.

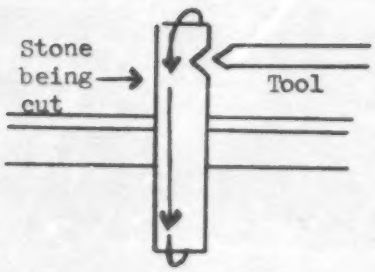
Steps For Cutting Grindstones:



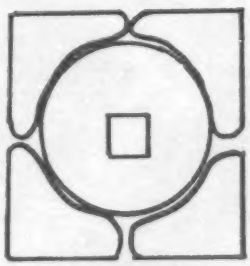
(1) Sandstone quarried into flat, square piece



(2) Square hole cut in middle



(3) Stone turned on shaft and shaped by cutting tool



(4) Result is round grindstone and four corners.

Challenges:

Find four corner stones, "remains" from grinding wheels, cut from Berea Sandstone. Fit the corners together and estimate the size of stone from which the wheel was cut. Remember the weathering of the corners will effect the fitting. Make certain that the stones you use are about the same size.

"Drawings adapted from Cleveland Metroparks materials courtesy of the Cleveland Metroparks Department of Interpretive Services"

STOP K: BEDFORD SHALE (continued)

Points to Ponder:

1. How did so many "corners" accumulate in one place? Has the river washed them to this spot? If so, why haven't they continued to travel with the stream? Were the stones shaped here? If so, why is there no record of a mill at this exact point?

2. What evidence of diastrophism do you see here? What do you suppose caused this warping of the earth? Why is there diastrophism here but not evident in the Cleveland and Chagrin Shales we saw today?

3. How does the Bedford Shale differ from the Cleveland and Chagrin Shales?

Additional Observations:

STOP L: THE POTHOLES

Time Allotted: 40 minutes
For Additional Information
See Pages 44, 45

Instructions:

Park the bus at parking area at top of the hill. Proceed single file down the path. Remind students to remain in single file and not to get ahead of the leader. At high water times, this can be a hazardous stop. However, it can be very safe if good judgment is used by leaders and students. This includes not allowing more than 6 - 8 students (one working group) on the "rocks" at one time.

Challenges:

1. Describe the flow of the river here as compared with the river at Scenic Park. _____

_____

_____

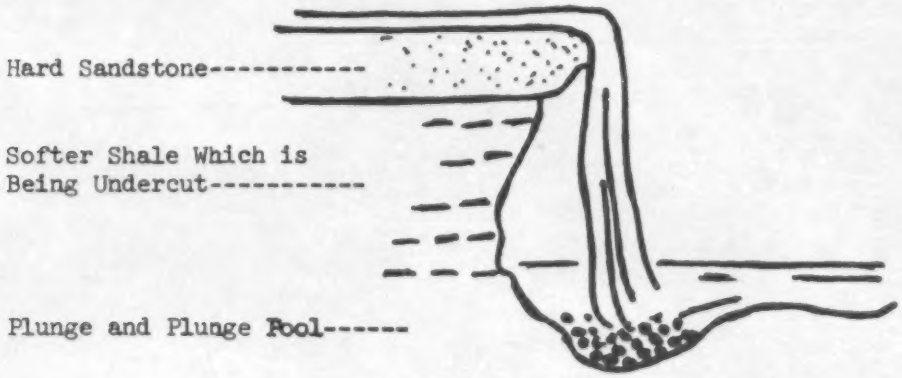
2. What kind of rock formation is found here? _____

_____

3. What has caused the huge sandstone boulders to break away from the original foundation? _____

_____

4. Which "fall" best fits the description given in the drawing?



"Drawing adaption courtesy of the Cleveland Metroparks Department of Interpretive Services."

Additional Observations:

_____

_____

_____

_____

SUPPLEMENT B

GLOSSARY

GEOLOGICAL TIMETABLE

Era	Period	Began (Millions of Years Ago)
CENOZOIC "Age of Mammals"	Quaternary	1
	Tertiary	63
MESOZOIC "Age of Reptiles"	Cretaceous	135
	Jurassic	181
	Triassic	230
PALEOZOIC "Age of Amphibians"	Permian	280
	Pennsylvanian	310
	Mississippian	345
"Age of Fishes"	Devonian	405
"Age of Inverte-brates"	Silurian	425
	Ordovician	500
	Cambrian	600
PRE-CAMBRIAN		4,600 (Estimated)

GLOSSARY

alluvial: stream deposits; unconsolidated sediments

anticline: folded layered rock with the curve on top ⌒; the older rock is toward the center of the curvature

brachiopods: marine shelled animal with two unequal shells each of which is normally bilaterally symmetrical

Cambrian: the oldest of the system into which the Paleozoic stratified rock are divided (See Geological Timetable on page xxiv.)

carbon 14: age-dating; when an organism dies, it no longer assimilates carbon 14, and the radiocarbon present in it decays without any new carbon 14 replacing the old

Cladoselache: 300 million year old shark

conodonts: tiny tooth or jawlike fossil; may have derived from annelid worm or fish

crustaceans: subphylum of arthropods with two pairs of antennae and generally jointed appendages; they normally breathe through gills

deposition: the laying down of potential rock-forming materials; sedimentation

Devonian: the fourth in the order of age of the periods in the Paleozoic era; sometimes called the "Age of Fishes" (See Geological Timetable on page xxiv; also the system of layered rocks of that period.)

diastrophism: definition as used in this booklet is the folding and faulting of the layers of sedimentary rocks

dolomite: a common rock-forming material very much like limestone

Dunkleosteous terrilli: a giant armored fish

erratic: rocks and boulders carried by glacier ice

flood plain: land that is built of sediments deposited by the river

formation: something naturally formed, that is noteworthy for some geological reason

glacial drift: any rock material, such as boulders, till gravel, sand or clay, carried by and deposited by a glacier

glaciation: changes of the earth's solid surface through erosion and deposition by glaciers

hogback: a sharp ridge that decreases in height at both ends until it meets ground line

Ice Age: the period when glaciers were here

interbedded: layers lying in a bed parallel to other beds of different materials

intrusions: one rock pushes its way into an older rock

isostasy: the theory that all large portions of the earth's crust are balanced as if floating on a denser underlying material, almost as if "mirrored"

limestone: sedimentary rock made from shelled sea animals

load: the sediment moved by a stream whether in suspension or on the riverbed

lower invertebrates: animals of various shapes and sizes that have no backbone

mature flood plain: a flood plain that has existed long enough to have older trees

meandering stream: a river that has a number of river-developed curves

mill race: the channel in which the current of water driving a millwheel flows to the mill

Mississippian: the fifth of seven periods in the Paleozoic era. (See Geological Timetable on page xxiv.)

monocline: layer that angles down in one direction and does not form sides of an anticline or syncline

moraine: drift, deposited chiefly by direct glacial action

Ordovician: the second of the periods in the Paleozoic era. (See Geological Timetable on page xxiv.)

outcrop: the exposure of bedrock projecting through the overlying soil

oxbow: a crescent-shaped lake formed in a riverbed which has become separated from the main stream by a change in the course of the river

plunge pool: potholes, in general, of large size, occurring at the foot of a vertical or nearly vertical waterfall

Pre-Cambrian: all rocks formed before Cambrian times

pre-glacial river valley: a river valley that existed before the glacial period

Pennsylvanian: the sixth of seven periods in the Paleozoic era. (See Geological Timetable on page xxiv.)

Permian: the last period of the Paleozoic era. (See Geological Timetable on page xxiv.)

retaining walls: a wall built to hold back a mass of water or earth

riffle: a shallow extending across the bed of a stream; a rapid of comparatively little fall

sedimentary: rock formed from sediments

sediments: solid suspended material that has been transported by air, water, or ice, and has come to rest on the earth's surface

shale: materials of mostly clay cemented into sedimentary rock

siltstone: a very fine-grained consolidated rock

Silurian: a geological period between Ordovician and Devonian (See Geological Timetable on page xxiv.)

stream piracy: one river takes over another and they become one stream

syncline: a fold in rocks that dips down

talus slope: a collection of fallen disintegrated material which has formed a slope at the foot of a steeper hill

terminal moraine: a moraine formed across the course of a glacier at its farthest advance at or near a relatively stationary edge, or at places marking the termination of important glacial advances

till: nonsorted sediment carried or deposited by a glacier

trilobites: an index fossil identifying a specific geological time; an arthropod

watershed: the area in which all the ground waters run to a specific river

weathering: rocks changing in character, decay, finally crumbling into the soil because of exposure to the weather

SUPPLEMENT C

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BIBLIOGRAPHY

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ABOUT THE AUTHOR

Mary Ellen Cabbage is a fifth and sixth level team teacher at Goldwood Elementary School, Rocky River, Ohio. Her students proudly identify their class as "007." Over the past twelve years, Miss Cabbage has been instrumental in the development of "007" into an instructional program designed to meet the needs of the individual student through large group, small group, and one-to-one instruction.

Miss Cabbage's primary responsibility as a team teacher is math and science, but she does teach all areas. In addition, her classes utilize many adult volunteers.

Her educational background includes a B. S. degree awarded at the University of Iowa and a M. A. degree awarded at Case Western Reserve University. She was also the recipient of a grant to attend a National Science Foundation Summer Institute in the area of math and geology at the University of Oregon and has attended the National Audubon Camp in Maine.

She has conducted several teacher training programs within Northern Ohio. These included: math workshops for both Mansfield City Schools and the Rocky River City Schools and a five school-district geology workshop series sponsored by the State of Ohio Department of Education.

Miss Cabbage has received the Martha Holden Jennings Foundation Scholar Award and a Jennings grant to study individualized reading. She has also developed curriculum units for elementary school social studies.

The materials included in this text have been compiled and field tested by Miss Cabbage over a period of fifteen years. They reflect many hours of research, development, and student involvement.

P. M. M.

ESEA Title III